TURN OVER A NEW LEAF
Fine-tuning koala diets

AN EVEN PLAYING FIELD
Tackling social exclusion

SURGICAL SIMULATOR
Glove enables remote learning

FUTURE-MAKERS

THE PROBLEM OF PLASTIC

Changing behaviour for a world in crisis

WESTERN SYDNEY
UNIVERSITY

Special Issue on the UN Sustainable Development Goals

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ABOUT THIS MAGAZINE

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Aboriginal and Torres Strait Islander peoples should be aware that this publication may contain the images and names of people who have died.

ABOUT

Western Sydney University is a large, student-centred, research-led university. Established in 1989, the University proudly traces its history to 1891 through the Hawkesbury Agricultural College. Today the University has more than 200,000 alumni, 45,000 students and 3,300 staff.

The University is now ranked in all major global university ranking systems, and is in the top 2% of universities worldwide. Through investment in its academic strengths and facilities, the University continues to build its profile as a research leader in Australia and is nurturing the next generation of researchers. Western Sydney University graduates go on to take up rewarding careers that make real contributions to societal change, lifting the pride of students, staff and the community.

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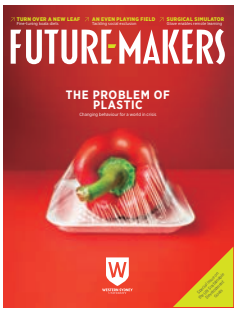

↗ Solving the plastic waste problem will require widespread business and social change, not just technological innovation (page 35).

Cover image:
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MAKING A DIFFERENCE ON A LOCAL AND GLOBAL SCALE

As we welcome you to this special edition of *Future-Makers*, we are delighted and proud to again share with you a landmark moment for Western Sydney University, as we are recognised as **number one worldwide** in the 2022 Times Higher Education University Impact Rankings — an international acknowledgment of our efforts to drive social transformation. The Times Higher Education Impact Rankings assess universities against the United Nations' Sustainable Development Goals (SDGs) across four areas: research; stewardship; outreach; and teaching.

As a leading advocate for the region, Western is embedded in the economic, cultural, and social life of Greater Western Sydney — a region experiencing first-hand many of the sustainability and resilience challenges of the 21st century, including rapid urban growth, urban heat and areas of socio-economic disadvantage. In this SDG Special Issue of *Future-Makers*, we bring you the stories of Western's research excellence, demonstrating our strong commitment to tackling society's grand challenges and supporting a more just and equitable world. The issue is testament to the staunch resolution of our researchers to making a societal impact by reducing inequality, addressing issues like food and water security and the effects of climate change, both locally and globally.

The range of research stories presented to you in this special edition of *Future-Makers* provide insights into the impactful work of our researchers across a number of SDGs. The issues tackled include combating Islamophobia through innovative multimedia tools, greening our cities by planting vegetation along light rail tracks, managing plastic packaging waste, understanding how people with intellectual disability experience the transition from school to adult life, boosting diabetes prevention through community intervention, making sport more inclusive through flexibility in dress codes, and using the stories of society's most vulnerable to effect positive change for renters, to enhancing survival rates of koalas.

This research breaks new ground, offering solutions to the challenges faced by the modern world. We encourage you to read these stories, and to connect and collaborate with our researchers to co-investigate and co-create a more conscious, healthy, equitable, and sustainable society.

Professor Barney Glover AO
Vice-Chancellor and President

Professor Deborah Sweeney
Deputy Vice-Chancellor and Vice-President (Research, Enterprise and International)

SUSTAINABLE DEVELOPMENT GOALS

The United Nations' Sustainable Development Goals (SDGs) are a blueprint towards a better, more sustainable future (see: sustainabledevelopment.un.org). Western has many research projects aligned with these goals. We have indicated the most relevant SDG above each article in this issue of *Future-Makers* where applicable.

A CHAMPION OF SUSTAINABLE DEVELOPMENT

Western Sydney University recognised for contribution to the United Nations' Sustainable Development Goals.

Western Sydney University has been named number one in the world overall for its social, ecological and economic impact in the 2022 Times Higher Education (THE) University Impact Rankings.

In these rankings, universities are assessed against each of the 17 United Nations' Sustainable Development Goals (SDGs). The score is based on their research, stewardship, outreach and teaching. In 2022, 1,406 universities from 106 countries/regions were included in the rankings.

In addition to clinching the top position overall, Western was in the top 10 universities for 7 individual SDGs. Of particular note is SDG 6 Clean water and sanitation, SDG 12 Responsible consumption and production, and SDG 5 Gender equality, for which Western ranked first, second, and third in the world, respectively.

"Social justice, inclusive education, addressing inequality, environmental stewardship and resilience — these are all core to our mission. We are committed to delivering action in all these areas and fostering the next generation of thought leaders and civic-minded citizens who can solve these complex challenges," says Professor Barney Glover, Western's Vice-Chancellor.

"It is an immensely proud moment in the University's history to see our sector-leading efforts to drive important social transformation recognised."

FINDING THE X-FACTOR IN RESILIENCE

Crucial insights from a collaborative Western Sydney University-Mission Australia study could help identify and help families at risk of homelessness.

1 NO POVERTY

Nathan decided it was time to leave home when he had to sleep in the same bed as his two-year-old to stop his partner from taking the toddler with her to score drugs during the night.

For parents like Nathan (not his real name), the decision to flee violence and substance abuse often leads to homelessness. But Nathan had a different experience and now his journey to securing a home for himself and his son is helping inform research on family homelessness.

The Mission Australia Centre Kingswood (MAC-K) family homeless project, led by Western Sydney University's Dr Elizabeth Conroy, is breaking new ground thanks to insights gleaned from clients like Nathan.

As Conroy, from the University's Translational Health Research Institute, points out, research is scant on family homelessness in Australia. "Families account for just over half of all people accessing specialist homelessness services in Australia," she says. "Yet we know little about their experiences because the research, where it exists, is mostly from the US."

The chance to address that lack of knowledge came in 2014 through a collaboration with Mission Australia, who had opened MAC-K as a centre for bringing together its services for disadvantaged families in western Sydney.

Conroy says the MAC-K project provided an opportunity for her team and Mission Australia to better understand both the risk and what allows some people to avoid family homelessness.

"Although we know poverty is a key driver of homelessness, it is not deterministic — it doesn't mean you will necessarily end

NEED TO KNOW

- The number of homeless people in NSW has increased by 37% since the 2011 census (based on 2016 data).
- The MAC-K family homeless project aims to understand how some people avoid homelessness despite having similar risk factors as those who don't.

This project was funded by Mission Australia.

up homeless." The study, she explains, aimed to understand how some people escape homelessness despite having similar structural risk factors as those who don't.

The project involved one-on-one interviews with Mission Australia clients about their lives and the circumstances that led to their current situation. "We looked for commonalities across these stories, and the key tipping points or risks that elevated people's likelihood of becoming homeless," explains Conroy. The interviewers also explored resilience in clients and how they overcame challenges.

Mission Australia Western Sydney area manager, Julie Jasprizza-Laus, worked with Conroy on the project, and says it was inspiring to see Conroy's team bring academic insights into the field.

"To have clients' stories heard, and evidence provided on what is and isn't working to help them is really beneficial, because in our sector there isn't a lot of evidence on how to support families," Jasprizza-Laus says.

Importantly, the research was able to identify what Jasprizza-Laus calls the "X factor," families that "can experience trauma and debt and be able to navigate through it".

"It means we can identify very early those families that don't have the resilience and wrap some services around them for support," she adds.

Of the 14 interviewees, four Mission Australia clients including Nathan, had not experienced homelessness — and the "X factor" for each, was the existence of at least one family member who was always there for them. "Trauma, grief and loss were still quite prominent in their stories," Conroy says, "but they at least had one person they described as 'their rock' and were able to draw on that support."

© Nareshkumar Mani/EyeEm/Getty

"WHILE THIS GROUP IS VULNERABLE, IT ALSO HAS AN INCREDIBLE AMOUNT OF STRENGTH."

Nathan's rock was his mother. The pair had formed a tight bond when they were forced to flee Nathan's violent father. When Nathan could no longer live with his partner due to her drug use, he moved in with his mother and stepfather. When his ex-partner and her associates threatened violence, Nathan and his son moved interstate.

Subsequently, he returned to Sydney to support his mother after his stepfather died. It took five years for him to secure his own accommodation, with the help of Mission Australia, and he now lives within walking distance of his mum. "Everything I do, I do it for my son. He has made me a better person," he told interviewers.

Conroy says the support of a key individual is critical. Two other factors highlighted by the research: the importance of belonging to family; and achieving the right balance of self-reliance and support, also help stop the slide into homelessness.

With the knowledge gleaned from the interviews and a survey of clients, the research team then held workshops with Mission Australia staff at the Kingswood centre to help them interpret the findings.

They also developed a reflective tool to improve the centre's practices; an outcome Jasprizza-Laus says has been invaluable.

"Having a framework that provides questions to ask each other and challenge your thinking so that you continually improve and stay present in what is happening with your families is an amazing tool to have," she says.

Jasprizza-Laus says the study will also feed into Mission Australia's wider advocacy work.

"It really shows the importance of early intervention and knowing how to build resilience factors in those families that might not have the resources they need," she says. "Having that evidence and research allows us to have strong proof behind our advocacy."

Away from Kingswood, Conroy hopes the pilot study will also help redefine the thinking about the homeless community at a political and social level.

"There is often a portrayal of people at risk as being 'leaners', and it tends to paint a picture of people being incompetent, not putting effort into their lives and making the wrong decisions."

But as Conroy emphasises, the MAC-K project quite clearly demonstrates that such a portrayal is unfounded. "One of the clear messages coming out of this work is that while this group is vulnerable, it also has an incredible amount of strength."

MEASURING AND MANAGING AN INVISIBLE RESOURCE

Putting research in the hands of village communities leads to coordinated and lasting improvements in groundwater management.

2 ZERO HUNGER

In many regions of India, groundwater is the main source of water for local communities, but years of overuse has critically depleted groundwater reserves, with dire implications for water and food security. While there are no easy solutions, Professor Basant Maheshwari's team at Western's 'Australia India Water Centre' and School of Science has shown that a transdisciplinary approach that brings together different disciplines and empowers local villagers as participants in the research, can open a new pathway for solving this complex problem.

"Groundwater overuse is a serious problem in India and nearby countries, and is becoming significant across South East Asia and Africa," explains Maheshwari. "Our project is about finding ways to improve the sustainability of groundwater use while improving the livelihood of village communities by solving a complex, people-related problem from a range of perspectives, including technical, social, environmental, economic, agronomic and policy points of view."

Initiated in 2011 and working in 11 villages across two watersheds in western India, the Managing Aquifer Recharge and Sustaining Groundwater Use through Village-level Intervention (MARVI) project is funded by the Australian Centre for International Agricultural Research, and the Australian Water Partnership. The project is a broad collaboration with the CSIRO, and agricultural research institutions and

Empty jugs waiting to be filled by a water supply truck in New Delhi, India.

(Left) Villagers monitoring groundwater levels in Meghraj. (Right) Basant Maheshwari and colleagues meeting with farmers in Sundarpur.

NGOs in India. The MARVI team put the community and their livelihood at the centre of interventions.

"The way we saw it, we had two options to address this problem. A conventional approach where we collect data, perform some modelling and analysis and develop recommendations, or a transdisciplinary approach where we bring people together to own the problem, engaging water users to monitor groundwater, learn together and develop their own water management science and strategies for collective action," says Maheshwari.

As Maheshwari recounts, while the conventional approach might have been easier, the project would have ended a long time ago with a low probability of those strategies translating to meaningful action. The alternative approach that the team undertook was time-consuming and difficult, but it has led to real and ongoing actions by communities and is already being replicated in other areas of India.

Through the MARVI project, members of the 11 village communities taking part in the initiative were trained as 'groundwater informed' volunteers to help communicate how groundwater supplies fluctuates, and to reliably collect groundwater level and rainfall data.

"Many doubted that villagers with limited formal education would be able to collect reliable groundwater data or understand the groundwater science," says Maheshwari. "However, the villagers disproved that apprehension and were able to collect reliable data and work closely with researchers."

Hari Ram, is one of the volunteer farmers from the Dharta watershed who participated in the MARVI project. "In the beginning, we did not know how measuring groundwater depth and rainfall would help us, but we knew that we needed to do something," he recalls. "Within six months we started getting a feel for how groundwater levels were fluctuating in the wells and how rainfall and groundwater pumping influenced the groundwater levels. This eventually helped us to estimate groundwater availability and decide on how much area we could irrigate until the crop harvest."

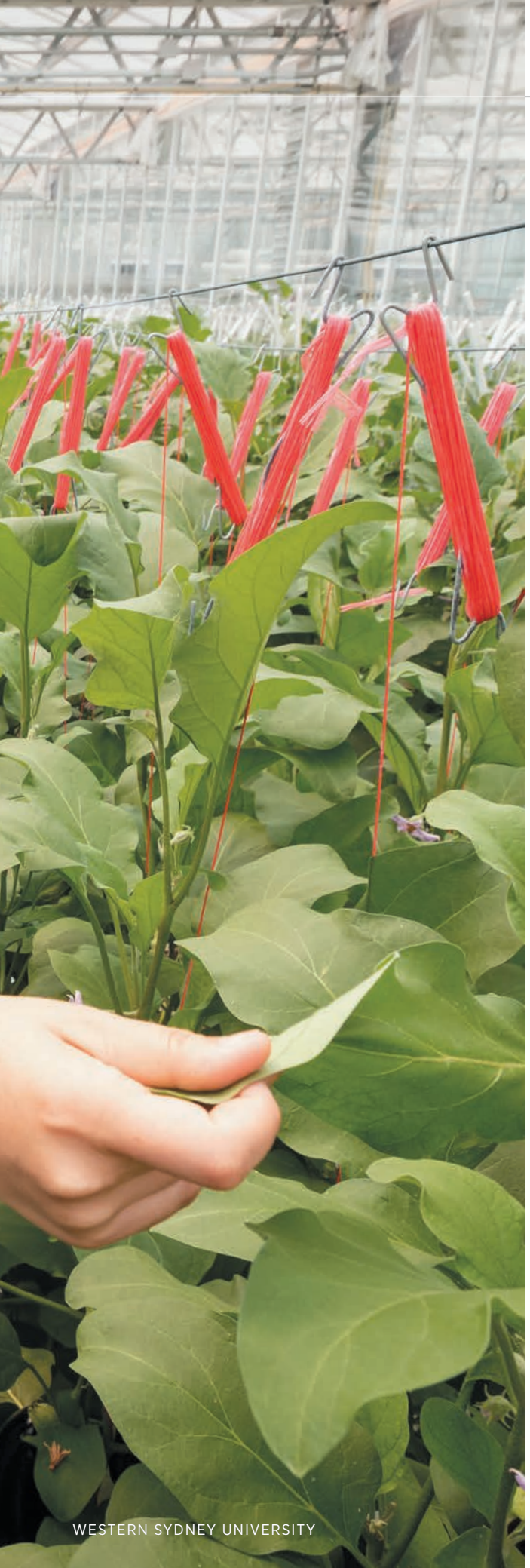
"The participatory, village-level monitoring approach empowers local communities to develop their own groundwater management dialogue and strategies," says Maheshwari. "By learning that they are pumping from a common pool resource, the communities were able to find their own solutions. Through the newly formed Village Groundwater Cooperatives, farmers were encouraged to work together to tackle their common problems."

The MARVI project is now being adopted by the Government of India, which is rolling out the programme in seven states covering more than 20,000 villages through a World Bank supported project, the Atal Bhujal Yojana – a National Groundwater Management Initiative.

NEED TO KNOW

- Groundwater reserves are becoming critically depleted in India.
- The MARVI project is finding ways to use groundwater more sustainably.
- It empowers local farmers to monitor and manage usage.

Xin He (front) and Yagiz Alagoz (back) in Western's glasshouse.



WESTERN SYDNEY UNIVERSITY

BRINGING AGRICULTURE INDOORS

Australian-led advancements in indoor cropping technologies provide hope for an increasingly strained agriculture sector.

2 ZERO HUNGER

As Australia's climate becomes more volatile and protracted droughts and extreme floods undermine the reliability of food production, Western Sydney University researchers have embarked on an ambitious protected cropping initiative to lay the groundwork for the future of agriculture.

Distinguished Professor David Tissue's group at Western's Hawkesbury Institute for the Environment is investigating how plants might respond to a changing climate, including variations in carbon dioxide levels, temperature, water and nutrient availability, and extreme climate events, in order to develop technologies that could help improve productivity in an increasingly uncertain future.

"Historically, the Australian environment has been highly variable, but climate change has increased that variability, leading to much higher temperatures and greater intensity of extreme climate events, including heatwaves, droughts and floods," says Tissue. "These environmental challenges and a rapidly increasing population, demand action to provide food security. Protected

NEED TO KNOW

- The future of food production may lie in protected cropping.
- The Hawkesbury Institute for the Environment opened a 1,700 m^2 greenhouse to investigate ways to optimise food production.
- Photovoltaic 'smart glass' may help reduce a greenhouse's energy costs.

This research was funded by Horticulture Innovation Australia and supported by the Future Food Systems Cooperative Research Centre.

cropping is one solution for horticultural crops."

While conventional cropping is vulnerable to the elements, indoor or protected cropping allows food growers to control all aspects of the crop's environment and manage resources such as water and nutrients in a more systematic way. This can dramatically improve yields and reliability, but comes at a significant increase in cost.

One of the technologies that Tissue's team is investigating is light-blocking and light-shifting films or 'smart glass' for glasshouses. "The idea is that innovative smart glass technologies and films can reduce the heat load inside a glasshouse and so reduce energy costs, while maintaining or improving crop productivity and quality with reduced water and nutrient use and the possibility of renewable energy generation," says Tissue.

In 2017, with the support of the industry research and development agency Horticulture Innovation Australia (HIA), the Hawkesbury Institute for the Environment established the National Vegetable Protected Cropping Centre (NVPCC) — a huge, 1,700 m² research glasshouse with eight rooms that can be independently controlled to adjust environmental parameters such as carbon dioxide level and temperature. It also provided an ideal structure for the trial of smart glass technologies.

"We found that while the smart glass reduced energy use inside the glasshouse, it also reduced overall light intensity and some wavelengths of light, including red light which is important for photosynthesis," says Tissue. "Two plant varieties, eggplants and capsicum, were tested inside the smart glass," says Dr Chenchen Zhao, a postdoctoral fellow in Tissue's lab. "The eggplants had a decreased crop yield, compared to the smaller fruit, capsicum, which were not affected as much in terms of crop yield in the smart glasshouse."

"WE ARE DESIGNING A NEXT-GENERATION SMART FILM."

An aerial view of the glasshouse, the blue-tinted glass is the Smart Glass.

(Left to right) Chelsea Maier, Chenchen Zhou, Yagiz Alagoz, Norbert Klause and Xin He.

"The reduction in light led to reduced carbon availability and subsequently reduced crop production, although it also led to lower nutrient and water use," explains Tissue. "Importantly, we identified the limitations to the current smart glass specifications and have developed some ways to improve it."

"The research group is working toward developing a film that will reduce wavelengths of light that generate heat, but do not affect plant development, while allowing full transmission of wavelengths that are crucial for fruit production," says Tissue.

The NVPCC research underpins the Future Food Systems Cooperative Research Centre (CRC) at Western Sydney University in collaboration with the University of New South Wales and other institutions nationwide.

"Through the substantial support of HIA and the Future Food Systems CRC, we have been able to address many of our main objectives by involving technicians, PhD students, and post-doctoral researchers in the research, and developing new technical solutions to maximise food production while minimising resource use and costs," says Tissue. "We are designing a next generation Smart Film based on significant progress in the smart glass project through Western's role in the CRC, where we will further modify the technology to provide even greater benefit to crop production by leveraging greater technical capacity including robotics and hyperspectral cameras."

WHY PAYING A VISIT PAYS OFF

Volunteer visits are helping isolated parents feel more confident and optimistic.

3 GOOD HEALTH AND WELL-BEING

A program whereby volunteers visit people's homes is helping vulnerable parents in need of extra support. Volunteer Family Connect (VFC), matches families of young children with trained volunteers who visit once a week for between three months to a year.

"My visits could involve reading to the kids while the parents cook dinner, going to the doctor together, or simply listening to their concerns," explains Kathleen McKinnon, a volunteer who has worked with several families. "It's only two hours a week, but it makes a huge difference to the families."

In addition to anecdotal evidence, social scientists are working to demonstrate empirically that programs like VFC make a difference.

In 2012, the government cut funding from volunteer home visiting programs citing a lack of evidence for their effectiveness, explains Associate Professor Rebekah Grace, chief investigator and Director of TeEACH (Centre for Transforming early Education and Child Health) at Western Sydney University. "If the only reason for the funding reduction was the lack of evidence, what we had to do was clear," says Dr Jayne Meyer Tucker, a former CEO of one of the three national not-for-profits that partnered on the research. She initiated crisis meetings with the research team. "We chose to run a randomised control trial, the gold standard methodology in assessing program effectiveness, which randomly allocates families to either receive the service or to continue on without the support of a volunteer."

Getting the program implementation staff, the volunteers, and volunteer coordinators on board with the trial, however, was a challenge. "The volunteers and coordinators are very motivated by the drive to help families make positive change. They worried that families in the control group were essentially being denied help, and the idea was heartbreaking for them," says Grace. "We went to each of the seven trial sites many times to talk to program volunteers and staff about why we needed to employ this methodology, to help them understand that the trial would give us the strongest evidence possible to argue for the survival of this program. This helped reframe their thinking."

© VFC

The trial commenced in 2015, and the analysis has been completed, showing that families who received the service felt more competent with parenting, were better connected to the community, experienced improved wellbeing, and were more optimistic about the future than those in the control group. Moreover, they showed volunteer improvements such as wellbeing, community connection, and sense of purpose.

VFC currently operates with funding from an anonymous philanthropist, and the team continues to advocate for government funding. The team's analysis shows that government investment in programmes like these ultimately produce savings by preventing small problems from worsening into those that require more intensive intervention.

Following the trial, two additional communities have contacted the academics asking for the VFC programme to be implemented in their areas. As a result, programmes are underway in Taree on the northern coast of New South Wales and in an indigenous community in Wanslea in Western Australia.

A social impact evaluation, underwritten by Ernst and Young, was performed in tandem with the study to value the improvements and social benefits generated from Volunteer Family Connect. They found that every dollar invested achieved a $1.78 to $5.42 return in social benefits.

"Even if you're economically well off, it's quite alarming how isolated and distressed you can feel as a new parent without a support network," explains Dr Kelly Baird, project manager and Research Fellow at Western. "Services are already available for parents who need professional care, like treatment for clinical depression, or who require more intensive tertiary parenting interventions. But we need to remember that the families who aren't at that level now, without intervention, could be at the edge."

"The issue with belonging is significant," adds Grace. "People are more isolated now than any other time. We need to be addressing social inclusion with the same seriousness and sense of urgency as we do with issues like smoking, alcoholism and obesity."

NEED TO KNOW

- 15% of Australian parents report feeling isolated.
- The Western team's study was the largest trial of volunteer home visiting worldwide.
- The program demonstrated financial, social and health benefits.

HANDY TOOL TRAINS SURGEONS

Electronic gloves help transfer knowledge from master surgeons to students.

3 GOOD HEALTH AND WELL-BEING

NEED TO KNOW

- The surgical skills needed today are more complex than in previous decades.
- Gough Lui and the team at MARCS have developed electronic gloves to help trainees learn from the movements of skilled surgeons.
- The gloves have proven popular with students.

Researchers from Western Sydney University, in consultation with Liverpool Hospital, have developed tools to help trainee surgeons master intricate surgical procedures.

Gough Lui, a biomedical engineer at Western's MARCS Institute for Brain, Behaviour and Development, has worked closely with Liverpool Hospital for a number of years. "We get engineers to sit in with clinicians to identify problems and inspire solutions that can really make a difference," he says. In one of these sessions, Clinical Dean and Foundation Professor of Surgery and Colorectal Surgery, Professor Les Bokey, discussed with Lui the possibility of training surgeons in a more objective and evidence-based manner to ensure competency.

A big hurdle is that the surgical skills needed now are more complex than in previous decades. Surgeons must master open surgery, keyhole surgery with cameras, and robotic surgery, for instance. But while techniques have advanced, teaching methods had not greatly changed. In training, an experienced surgeon watches over the student's shoulder, giving feedback. "Often they say, 'that wasn't very good,' but can't concretely articulate what is wrong," says Lui. "That's very frustrating when you're trying to master a skill, but not seeing a way forward."

One positive advance in training has been that students can now practise on simulators. But these are hugely expensive, and trainees in typical hospitals rarely have easy access.

To solve the problem, Lui has developed surgical gloves containing flexible electronics to record the subtle, fast and controlled hand movements of skilled surgeons. When worn by students, the gloves can monitor how their hand motions differ from those of the experts. Lui hopes that the gloves will eventually be coupled with a smartphone app, so trainees can practice tasks at home, for as little as $100 — a fraction of the cost of a simulator.

Creating the perfect gloves is a work in progress. At first, Lui placed electronics on the back of the glove, to detect acceleration and hand orientation, and added force-sensors in the fingertips. But experienced surgeons reported that they reduced their touch sensitivity and were too bulky, hindering movement. Lui has looked at alternatives including the use of force sensors located further up the forearm and motion sensors on the back of the hand for an upgraded version, before finally settling on a design involving a mix of flexible electronics that has sensors for each segment of the finger.

"Now we have a tool that can assist in objectively measuring the intricate hand manoeuvres," says Bokey. Trainees who have participated in the development of the prototype can readily appreciate their potential contribution to training.
Lui quips that students even loved the clunky early version. "They are excited because they can see the promise," he adds.

Lui is working out how best to deliver useful instructions to trainees. The gloves collect motion data and relay them to a screen, where even the tiniest jitters are visualized. This can be distracting to students concentrating on difficult tasks. Alternatives include 'haptic' feedback — whereby the fingertips vibrate — or audio feedback to guide trainees along the right path. But Lui is cautious in case students become overly reliant on the technology. "In reality, human debriefing is always better than computer feedback alone," he says. "This is not a replacement for trainers, but it will augment their ability to give advice."

Concept validation trials have been underway, with the latest flexible iteration due for trial in early-2023, says Lui. If successful, the gloves could have unexpected uses. "We've already had requests from musicians asking if these gloves could help people become more skilled performers," says Lui. "They could have a wider impact than we ever hoped."

This research was supported by the South West Institute for Robotics and Automation in Health, the South Western Sydney Local Health District, and the James N. Kirby Foundation.

Dr Gough Lui demonstrating a smart glove, the sensor is indicated by the dotted circle.

BOOSTING DIABETES PREVENTION

A community intervention program has improved the health of people of Samoan heritage in south-western Sydney.

3 GOOD HEALTH AND WELL-BEING

A doctor approached

a Western Sydney University diabetes expert, Distinguished Professor David Simmons from the School of Medicine, at a conference, and explained how she was struggling to treat patients of Samoan heritage. She described how many of her patients in south-western Sydney were being treated in hospital, or dying from avoidable complications of diabetes.

Simmons relayed the conversation to his colleague at Western, Dr Freya MacMillan, an associate professor in the School of Health Sciences, and this became the impetus for Simmons and MacMillan to establish a pilot study. With three Samoan churches in south-western Sydney, they set up a reference group of community leaders to advise them in the project. Churches are the central meeting point for the Samoan community both in their home country, and in Australia.

Australia has a significant number of immigrants from the Pacific Islands. According to the 2016 census, 75,755 people are of Samoan heritage and more than 40% of them live in New South Wales. Samoans have an inherited predisposition to diabetes, but prior to the Western study, there was little research on the effectiveness of public health interventions to reduce the health risks of diabetes in this immigrant group.

In 2017 MacMillan and Simmons' team developed a program called *Le Taeao Afua* (the new dawn) derived from evidence-based research on community interventions and tailored by participants themselves to fit the Australian-Samoan lifestyle. The University trained a Samoan community activator, who in turn trained 20 church volunteers to become peer support facilitators.

Of the 187 participants first enrolled, 96% were overweight or obese and 32% had Type 2 diabetes. "The really worrying thing was that 13% didn't even know they had diabetes until we tested their blood," says MacMillan.

Volunteers developed workshops and more than 100 activities covering 12 public health messages dealing with diet and exercise. These included cooking classes that introduced people to new vegetables, and also revived other vegies used in Samoan culture, or promoted steaming and grilling instead of deep frying.

"We looked at affordable and seasonal options to take away the stigma that healthy eating is expensive," says Ronda Thompson, the community activator. Zumba classes, resistance band exercises and family power-walking were some of the physical activity favourites. Feedback suggested that competitive activities were motivating, says MacMillan.

After 3-8 months, the participants had statistically significant reductions in HbA1c levels, average blood sugar for the past two to three months, showing that the project had improved people's health. MacMillan says the average blood glucose reduction was the equivalent to a reduction from a dose of diabetes medication.

Following the pilot's success, the University secured $4.5 million to roll their program out to 48 churches encompassing other Pacific communities across Sydney over the next five years. The team will train more community activators to reach more than 3,600 adults and 1,000 children.

After the arrival of COVID-19, MacMillan says the group quickly pivoted resources towards providing vaccination information to Pacific communities. This process taught them valuable lessons about how to organise baseline data collection for their diabetes project. "We found that getting multiple churches to come to what had been our 'Covid hubs' was resource-effective," says MacMillan.

"We're thinking about affordable translation," she explains. "And by empowering communities, our goal is to embed this program into the health care system."

NEED TO KNOW

- Many people of Samoan heritage in south-western Sydney are at risk of diabetes.
- Western's Simmons and MacMillan developed a community intervention program called *Le Taeao Afua*.
- Program participants had significant reductions in average blood glucose levels.

IN THE 2016 CENSUS

75,755 PEOPLE
were of Samoan heritage

MORE THAN 40%
lived in New South Wales

$4.5 MILLION
Funding was secured from the Australian Government to roll out Le Taeo Afua to **48 CHURCHES**

Ronda Thompson; © vector/iStock/Getty

This research was supported by an Australia Awards Fellowship funded by the Australian Government.

EDUCATION FOR ALL

An Australian-led research project is helping teacher-educators in Papua New Guinea promote inclusive education for students with disabilities.

4 QUALITY EDUCATION

The 'UN Convention on the Rights of Persons with Disabilities (CRPD).' recognises the universal right to inclusive education. This can be difficult to facilitate, especially in countries like Papua New Guinea, where 85% of the population lives in remote and rural areas.

"Children with disabilities in these areas are often refused entry to formal schooling," says Genevieve Nelson, the Chief Executive Officer of the Kokoda Track Foundation (KTF). "Sometimes teachers and schools are the ones who refuse entry because they do not have the specialist skills to support children with disabilities to engage meaningfully in learning. Sometimes it's the parents who refuse to send them to school."

NEED TO KNOW

- Children with disabilities in rural areas of Papua New Guinea (PNG) have trouble accessing inclusive education.
- Researchers from Western led a project that helped PNG teacher-educator fellows promote inclusive education.
- The fellows' experiences will help inform PNG education policy.

KTF, a not-for-profit organisation that aims to establish the right to "an inclusive, equitable and quality education" for all, was a major partner in a project led by Western Sydney University researchers, Professor Danielle Tracey and Associate Professor Katrina Barker. The project provided specialist training to 10 teacher-educators to develop their capabilities to promote inclusive education at Papua New Guinea teacher colleges.

"We wanted to explore the level of understanding among officials within the PNG National Department of Education and various teachers' colleges, and to support them to strengthen policy and practices related to inclusive education, especially in remote and rural areas," says Nelson.

RESEARCH SKILLS

The teacher-educator fellows received four weeks of training at Western followed by a week of further training, several months later, back in Papua New Guinea. At the end of the project, they reported that one of the most highly valued outcomes of their training was learning to conduct 'action research'. In other words, the fellows learned how to use research methodologies to critique and improve specific areas of teaching practice.

One of the fellows, Cathy Sowi, a curriculum officer of inclusive education at Papua New Guinea's National Inclusive Education Unit, used focus group interviews and surveys to investigate the inclusive education program carried out in a school in the National Capital District of Port Moresby. Her research aimed at understanding the program's context, effectiveness, and the implications for teaching and learning. After the project conclusion, she expanded her research to cover schools in three other provinces. "The recommendations that emerged from the Fellows' action research will contribute significantly to the development of inclusive education in Papua New Guinea," says Sowi.

Cathy Sowi at the National Inclusive Education Unit.

The Fellows presented their findings to the directors of Papua New Guinea's Department of Education, which is in the process of restructuring the country's schooling system. "We have an exciting opportunity to ensure that inclusive education and education for all is front and centre of this new agenda," says KTF's Nelson.

CONTINUOUS LEARNING AND TRAINING

The Fellows also helped put together a manual that provides teachers in remote and rural areas with practical strategies, skills and techniques to engage parents and communities with the aim of improving access to education for children with disabilities.

They also learned how to improve curricula, assess students' learning needs, use assistive technologies, and received teaching on the sociocultural construct of disability and on models of leadership.

Tracey and Barker, along with the ten fellows, are working collaboratively to disseminate the results of the research project. "Disseminating the results in collaboration with the Fellows is important to developing their capacity and ensuring the findings are meaningful to educators in Papua New Guinea," says Tracey. Additionally, following Tracey and Barker's initiative of offering Western's Master of Inclusive Education internationally, several Fellows and their institutes have already expressed interest in joining the program. They have also hosted shorter training sessions at Western for 26 Papua New Guinea teacher-educators in collaboration with KTF.

"It has been amazing for our trainers and educators to experience first-hand the professional university life at Western and to have access to their resources," says Nelson.

RAISING THE ROOF ON HOUSING INSECURITY

Using the stories of society's most vulnerable to effect positive change for renters.

5 GENDER EQUALITY

Single, older women who rent and have had low incomes throughout their lives often live in fear of eviction — and sometimes have to rely on charity for food. Western Sydney University's Associate Professor Emma Power has gathered first-hand accounts from these women to lobby for changes.

The gender wage gap means their superannuation is inadequate, and private rentals are out of reach, explains Power. "Single, older women are one of the fastest growing groups of homeless people in the country."

One of the most striking accounts she has heard was that of a Sydney-based tenant in her late 60s. The tenant had asked her landlord to repair a leaking roof. By the time he acted, after two years of requests, her rental accommodation was mouldy and 40% was uninhabitable. The landlord then increased the rent by 20%, which forced the tenant to move.

While recent amendments to the NSW Residential Tenancies Act 2010 now mandate minimum standards to be maintained throughout a tenancy, it is still very difficult for less wealthy, older tenants to negotiate for repairs because they fear rental increases or retaliatory eviction.

Power interviewed 46 female Sydney-based renters, aged from 55 to their early 80s. Participants were either on Newstart (an Australian government income support scheme for unemployed people), the disability or aged pension, or had very low or erratic earnings.

The soaring Sydney property market meant that a large proportion of their income was absorbed by rent, so many cut down on electricity, heating or food. Some relied on food handouts.

Power described one woman who worked in a low paid community services job. In winter, when heating bills were high, she relied on a church's weekly food pantry.

Power has advocated for changes to NSW tenancy laws so that rental housing standards are specific and measurable, as they are in New Zealand. She would also like to see JobSeeker increase, more social housing and an end to evictions without grounds. In 2020, Power published a report for policy-makers trying to drive such changes. It has been cited in Parliamentary debates in NSW.

In March 2022 the NSW Parliament established an enquiry into homelessness of people aged over 55. At these hearings, Power highlighted the importance of social housing and the struggles from being continually displaced.

"When I met older women who'd been offered a place in social housing, I asked them what it meant to them," she said. "Their response was nearly always the same…affordable rents in social housing brought them the capacity to plan. They still had to manage their money carefully, but they now had the capacity to independently buy food and cover essential bills."

Power is now interviewing more people accessing income support payments to better understand how they use social networks and crisis support to make ends meet.

NEED TO KNOW

- Single, older women are one of the fastest growing groups of homeless people in Australia.
- Emma Power conducted interviews to find out more about experiences with housing.
- She is lobbying for changes to NSW tenancy laws and housing support structures.

With rental prices soaring, many single, older women on low incomes in Sydney have to cut down on food and other necessities.

This research was supported by the Australian Government through the Australian Research Council.

TACKLING INCLUSIVITY

Flexibility in dress codes makes sport a more inclusive pursuit.

5 GENDER EQUALITY

When Amna Karra-Hassan founded the first mostly Muslim women's Australian Rules football (AFL) team in 2011 she had no idea of the impact it would have.

Although the western Sydney club welcomed women and girls of all religions, cultures and ethnicities, the sight of Muslim players deftly drop-kicking a ball while wearing headscarves, tights and long sleeves as part of their uniforms soon attracted media attention and commentary. Western Sydney University sociologist, Dr Jennifer Cheng, was not surprised.

As a member of Western's Challenging Racism Project, Cheng has been observing Muslim women and their relationship with sport since a chance meeting with Karra-Hassan in 2016.

She believes the female AFL players were seen as a bit of an oddity, as their participation went against the general belief that Muslim women were not allowed to play sport because of their religion. Cheng says there is a clear association between sport and 'Australianness' in society and failure to participate in sport is viewed as a failure to integrate into Australian culture and adopt Australian values.

Yet, through interviews with 13 members of the Auburn Giants AFL team, Cheng found religion had little bearing on the participants' decision to play a sport. Instead, she found that many of the women had played sport since they were young, with the support of their families.

Modest clothing is an important factor for some Muslim women and girls when deciding what kind of sport to play. "A major barrier to Muslim women's participation in sport is lack of accommodation by the various sports codes of their dress requirements," says Cheng. "That's why it's important to give them a full range of choices in sporting uniforms."

For the participants in the AFL study, dealing with Islamic dress requirements was possible because the AFL code allowed them to wear long sleeves and leggings or tights underneath the standard uniform.

Cheng says the Auburn Giants AFL example shows that small accommodations can be significant in enabling Muslim women to participate in sports of their choosing.

"Wearing conservative garments while playing Aussie Rules has not made the participants any less integrated or Australian, nor have they had to be less Muslim or less ostensibly Muslim," she says. "Indeed, the participants have to some extent normalised wearing a hijab while playing competitive sport."

Karra-Hassan agrees, adding that Cheng's research was an important contribution because it captured what they knew

"CODES NEED TO CREATE INCLUSIVE POLICIES SO MUSLIM WOMEN CAN PARTICIPATE."

An Auburn Giants player during an exhibition match in Melbourne.

This research was funded by the Freilich Project Early Career Research Small Grants Scheme.

anecdotally as a club: "That we need to create inclusive practices, and codes need to create inclusive policies to allow Muslim women to dress in a culturally and religiously appropriate way so they can participate."

Cheng has followed her 2016 AFL study with a further examination of Muslim women's participation in sport. This included interviews with Punchbowl United Football Club members, the Swim Sisters — a religiously diverse female swimming group — and mothers whose children played AFL. Cheng says this recent study has reinforced many of her earlier findings.

One new observation she made was that many Muslim women involved in sport reject the idea that they are breaking down barriers and stereotypes. "In a way putting them up as examples is confirming this idea that they are not the norm and they don't want to spread that image," she says.

Supporting this view is the Swim Sisters participant who said: "We don't get up and train at 5am because we want to challenge stereotypes, but because we want to train and you want to achieve the goal you set yourself."

Punchbowl United Football Club president, Natasha Hill, agrees with the sentiment. She says the club took part in the study to provide more information about Muslim women's participation in sport. "It helped give an insight into why we do it and how we do it," she says. "What we know is playing sport is becoming the norm in communities and Jennifer's research gave us a platform to highlight that."

Like the AFL, the local football association in Canterbury-Bankstown supported Punchbowl's female Muslims by agreeing to allow the club flexibility in its uniform to meet modesty requirements.

Similarly, the invention of the burkini in 2004 by Australian Aheda Zanetti was a game changer for Muslim female swimmers. One Swim Sister said, while in the beginning women wearing the burkini had to highlight the swimwear was "approved" to avoid criticism, its popular adoption meant "nowadays nobody says anything". Cheng says this example highlights how increased awareness can change attitudes.

Cheng believes her studies show the contribution of sport to social cohesion is not as simple as minorities integrating into mainstream competitive sports. Rather she says sporting codes can go a "long way" in engaging Muslim women by acknowledging the need to accommodate religious requirements such as dress code, women-only hours, and even alcohol-free social gatherings. Next Cheng will be looking at how ethnic backgrounds may factor into children's participation in extracurricular activities, both in Australia, which "largely considers itself a country of migration", says Cheng, and in Germany "which does not".

NEED TO KNOW

- Sport is associated with 'Australianness'.
- Muslim women are keen to participate in sport.
- Accommodating religious dress requirements can make sport more accessible.

ASSESSING MICROPLASTICS IN OUR RIVERS

A Western-led project involving students and volunteers is looking at microplastics in the Hawkesbury–Nepean river system.

6 CLEAN WATER AND SANITATION

Microplastics are causing concern globally, but very little is known about how they damage ecosystems. Studies have shown that they have a large impact on wildlife that inadvertently consume microplastics. "One impact that microplastics can have is that they can starve wildlife," says Michelle Ryan from Western Sydney University's School of Science "Microplastics swallowed by wildlife fill their stomachs and create a feeling of fullness, so animals no longer feed and starve themselves."

There are growing concerns that microplastics can impact human health too. "We know that microplastics enter the human body through the food chain and they have been found in the blood, organs and faeces," says Ryan. "The health impact of this has still to be determined."

To assess the amount of microplastics present in the Hawkesbury–Nepean river system, Western researchers and students, in collaboration with Streamwatch and Greater Sydney Landcare, conducted a workshop with volunteers from the community in June 2021.

Such activities are urgently needed since most research on microplastics to date has focused on the oceans, meaning that much less is known about their levels in river systems. Nevertheless, "microplastic concentrations in freshwater rivers could be potentially higher than in oceans, due to the lower water volume and rivers being smaller ecosystems," notes Ryan.

An analysis of samples collected during the workshop revealed an average of four pieces of microplastics per 3 grams, or a teaspoon's worth, of sand. "That's a lot considering how much sand and sediment freshwater systems have," says Ryan.

The analysis also indicated the origin of the microplastics. "These microplastics were made up of microfibres and microbeads from beauty products, clothing and towels. The major source of microplastics in river systems are from products that we use and wash down the drain."

Involving the community was a critical part of the workshop. "The whole reason I do environmental science is to bring about positive changes in the environment. It's imperative that I share my science with communities and educate them on environmental issues as it is the community who can bring about widespread, positive change in the environment," says Ryan. "When the community is educated about an issue such as microplastics, they can implement simple changes — something as minor as changing the brand of facewash — to reduce the amount of microplastics in the environment. All these small changes can result in a huge impact."

The project is ongoing. "It has been embedded into the curriculum for science students, and students undertook a microplastic assessment in the Hawkesbury–Nepean River in September 2022," says Ryan. "We also plan on running another community workshop in early 2023."

NEED TO KNOW

- On average, 3 grams of sand from the Hawkesbury–Nepean river system contains four pieces of microplastics.
- Most of the microplastics came from beauty products, clothing and towels.
- Volunteers from the community participated in the workshop.

Measuring microplastic sediment collected from the Hawkesbury-Nepean river system during a community workshop.

BENEFITS FLOW FROM WATER RESEARCH

Protecting communities from floods and preventing drinking water contamination are complex and costly challenges. Two Western researchers are using their childhood experiences of these problems to help create solutions.

Water engineer Ataur Rahman is coming up with innovative solutions to prevent flood damage.

6 CLEAN WATER AND SANITATION

Growing up in Bangladesh, Ataur Rahman knew well the devastation caused by flooding. Nearly a fifth of the country is flooded during an average year and three-quarters sits less than 10 metres above sea level, so he lived with the ever-present threat of inundation. "Bangladesh has a lot of flood problems," says the Western Sydney University water engineer, "so I had an interest in doing research in this area from a young age."

Several decades later, that interest led Rahman to a detailed study of flood risk across Australia and a research program that has changed the practice of flood estimation nationally. It has been translated into a web-based tool that offers governments, businesses and farmers a picture of what is likely to happen if a flood hits their region. The program's ultimate goal is to minimise future flood damage.

Floods account for nearly 30 per cent of Australia's natural disasters, and take a devastating toll. The damage caused by flooding in Queensland and New South Wales in February 2022 exceeded $4.8 billion.

Prior to this research, the existing method of flood calculation was limited by risk being estimated within state borders. Rahman and his colleague Khaled Haddad discounted arbitrary provincial boundaries, instead dividing the country into 14 regions based on hydrological patterns.

The design of what is now known as the Regional Flood Frequency Estimation tool was assisted by Professor George Kuczera of the University of Newcastle, and flood hydrology and water resource allocation expert, Erwin Weinmann. In all, the project involved collaborations from 14 organisations and the National Committee on Water Engineering at Engineers Australia.

"For any point in Australia, if you put in the latitude and longitude, you can assess the risk of flood. It looks at what could happen, and helps minimise the impact," Rahman says.

"It's very fast and easy to apply using a web interface. It has been used to design bridges and embankments, and to better protect the community."

It has been particularly valuable in rural areas, he notes, where it provides vital additional details for the safe and effective design of farm infrastructure.

If floods are already a major problem for Australia, climate change means that minimizing their damage will only become a bigger challenge in future. "The severity of rainfall is increasing and flooding is intensifying," Rahman says (see 'Debbie's Deluge').

The tool is already being used by local governments, state water agencies, road authorities and consultants. Rahman says it was recently used to estimate flood risk in 560 locations at once, delivering results within 30 minutes. It has been used as part of the Australian Rainfall and Runoff national guidelines, a public collection of data and software designed to help with risk mitigation and community resilience.

As the flood threat grows, Rahman intends to continue to develop the model. "Ultimately, we want to include more data to continually improve accuracy."

NEED TO KNOW

- Western researchers have developed a better flood-mapping tool.
- They also created a tool to assist water treatment plant operators.
- Both have been adopted by industry.

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DEBBIE'S DELUGE

In 2017, Tropical Cyclone Debbie and its remnants devastated Queensland, northern New South Wales and northern New Zealand. In Lismore, it pushed the Wilsons River to a peak of 11.59 metres, breaching a levee built in 2005 for the first time. The peak was not as high as previous floods in 1954 and 1974, but the speed of the river's rise was noteworthy. Earlier events have typically followed extended periods of rain. Debbie dumped most of its rain in 24 hours, and it happened in a year without the La Niña conditions that have typically contributed to earlier devastating floods on the east coast.

WATER TREATMENT

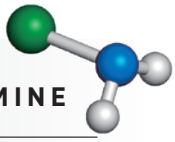
Rahman is not the only Western researcher to be bringing his formative experiences to bear on new solutions. A childhood in Sri Lanka and the enthusiasm of an early mentor led Western's Professor Sathaa Sathasivan to find a solution for treating drinking water.

"In Sri Lanka, people have trouble getting good quality water," Sathasivan says. "That was an area of concern to me."

Sathasivan had studied civil engineering before deciding to change direction and embark on doctoral studies in environmental engineering, where his PhD supervisor had a passion for drinking-water microbiology. The supervisor's enthusiasm was passed on, and Sathasivan has worked in the field ever since.

Sathasivan's work focuses on disinfectant technology.

Sathaa Sathasivan at Western's Penrith Campus.



CHLORAMINE

Ammonia is a simple compound made of one nitrogen atom, with three hydrogen atoms arranged around it. In chloramine, the structure is the same, but one hydrogen atom is replaced with a chlorine atom. The chlorine used for water disinfection has no nitrogen involved. Instead, it is two chlorine atoms bonded directly to each other.

Amongst other things, he has been investigating a chemical called chloramine (see box), a safer and cheaper alternative to the more standard water treatment approach.

The traditional method combines filtration to remove larger contaminants and chlorine to neutralise smaller contaminants such as bacteria and viruses. While chlorine is effective, it is also expensive and a potential health hazard, producing by-products when the chlorine reacts with other compounds that might occur in 'raw' water. Some of these by-products are thought to be carcinogenic, although the evidence is far from certain.

Chloramine, which is formed when ammonia is added to chlorine, does not produce these unwanted by-products, is considerably cheaper, and more resistant to break down than chlorine — lasting about ten times longer. All of this makes it a far more desirable chemical for water treatment.

However, chloramine has one major weakness: under certain conditions, bacteria may feed on free ammonia in the chloramine-treated water, producing a chemical called nitrite. The runaway chemical and biological processes sometimes consume all the chloramine in a water supply without any warning, leaving insufficient levels for effective treatment.

Sathasivan and colleagues addressed this problem, through a project funded by industry and Western by developing a tool to predict when runaway nitrification might occur.

The tool emerged from the team's research into factors that influence the likelihood of a nitrification event, such as the concentration of chlorine and ammonia in the water reservoir, the temperature and pH of the water, and other variables such as fluid dynamics within the reservoir.

The benefits of the research were so important that the Australian Research Council funded a Linkage grant of $1.1 million with industry funding from five water utilities in Sydney and Queensland.

WATER SAVINGS

The tool developed by Sathasivan and his colleagues does more than simply predict when nitrification events are likely to occur. It also helps water treatment plant operators decide what to do about a possible nitrification problem, and when to act; what dose of chlorine to use to bring the bacteria back down to safe levels; what impact this will have on the consumer; how long to treat; and also the possible impacts of outside events such as extreme rainfall, extreme heat or bushfires. It can also help identify infrastructure problems that might be contributing to a higher risk of nitrification, which can help with longer-term investment decisions.

Sathasivan's work is now being used by South East Queensland Water in its investigation of disinfection improvements. SEQ Water currently uses chlorine to disinfect at the treatment plant, but uses chloramine for secondary disinfection, when the water leaves the plant to its pouring out of the consumer's tap.

Brett Myatt, project lead for the South East Queensland disinfection optimisation project, says he's interested to see if disinfection improvements could be made.

SEQ Water regularly sends 1,000 litre-samples of their treated water to Sathasivan, who continues to run experiments modelling the effect of environmental conditions on nitrification.

This work has revealed that water's pH has a particularly significant impact on the risk of such events.

The findings are helping SEQ Water to prioritise their actions. "We're talking infrastructure investment of millions of dollars," says Myatt. "So it's making us confident it will have a significant effect."

WESTERN SYDNEY'S RIVER WARRIOR

Ian Wright's research helps keep coal mine pollution out of the waterways of the Sydney region.

6 CLEAN WATER AND SANITATION

Ian Wright's research often starts with a tip-off from community groups. That's how this Western Sydney University water quality expert became involved with stemming the flow of pollution from a coal mine in the Southern Highlands of New South Wales into Sydney's main water supply.

As well as being home to Australia's largest city, the 3.6 million-hectare Sydney Basin hosts coal mines, industry and environmentally sensitive locations such as water catchments, national parks and wilderness areas. One such mine, the Berrima Colliery was shut down in 2013 after operating continuously for more than a century. But, a local community group had become concerned about ongoing discharge into the nearby Wingecarribee River, which flows into Warragamba Dam. In 2014, they asked Wright to investigate.

Australia's most published scientist on water pollution from coal mines, Wright heads a water quality lab at the University's Hawkesbury campus. For 15 years, Ian and his team have been working to alleviate the impact of coal mines on rivers in the Sydney Basin.

The team's interest in the old mine deepened soon after the community approach about Berrima when NSW Environment Protection Authority (EPA) officers also raised concerns during one of Wright's regular meetings with the agency about discharge into the Georges River from another coal mine, the Westcliff Colliery (see map on page 27).

At the time, Westcliff was one of five collieries in the Sydney area from which Wright's team was regularly collecting discharge samples. He had been exchanging notes about the poor quality of Westcliff's discharge with the agency and the mine's owner, South32, for about five years. Prompted by Wright's observations, South32 recently built a $10 million water treatment facility for all their mines in the Westcliff area.

The impact of this facility has been significant. "The final effluent is brilliant," Wright comments enthusiastically. "You could probably drink it!"

WORLD LEADERS

Wright and his team's work with the EPA and other stakeholders has improved the NSW government's environmental regulation of coal mines, and is now considered an exemplar of international best practice in environmental regulation.

The Westcliff win was followed by another important project involving the EPA. Based on the results of research by Wright's team, the agency issued a revised environmental licence in March 2018 for the Clarence

NEED TO KNOW

- Tip-offs from the community revealed river pollution from coal mines.
- Western undertook long-term river monitoring.
- Their recommendations were adopted by authorities and industry.

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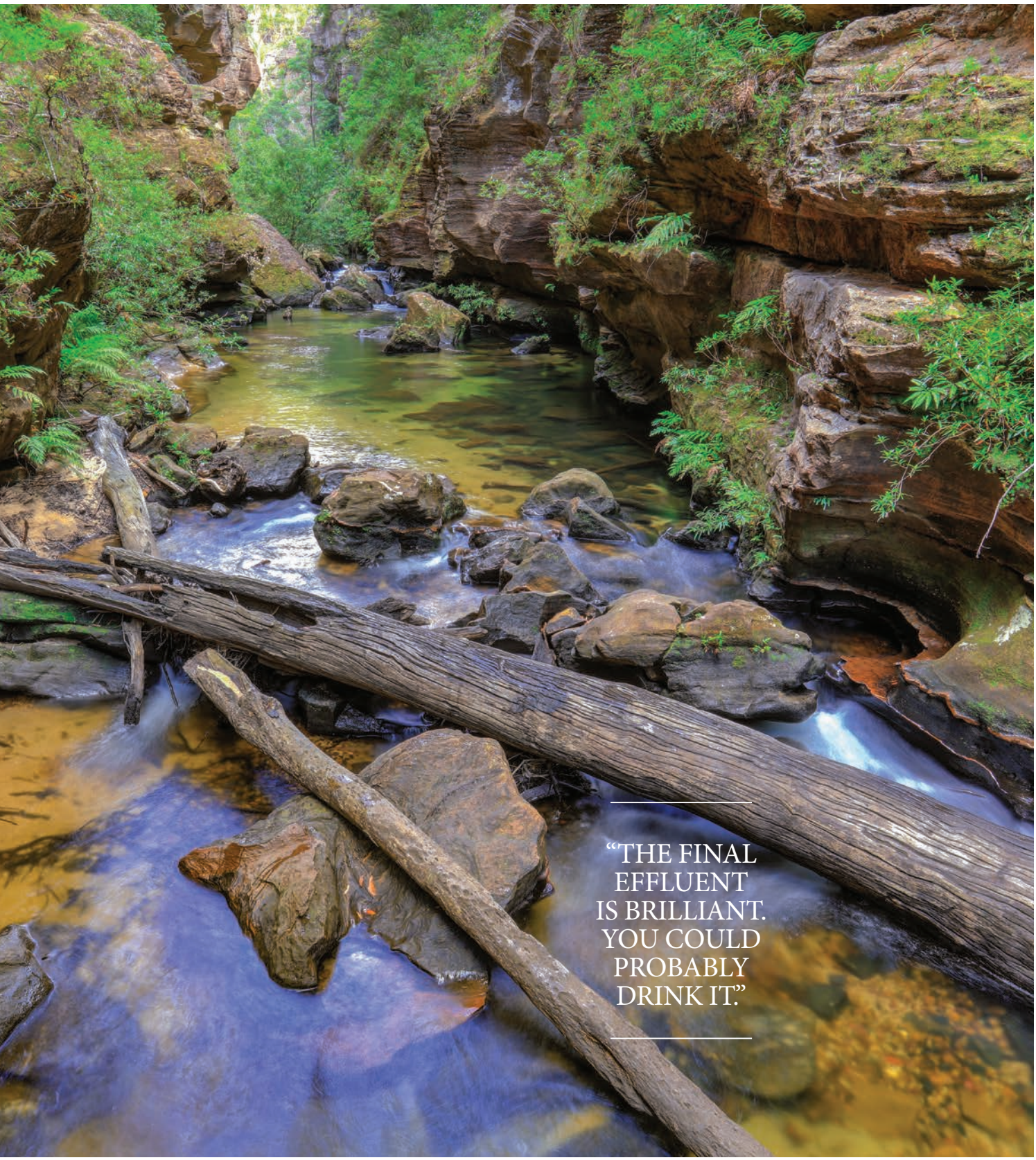


"THE FINAL EFFLUENT IS BRILLIANT. YOU COULD PROBABLY DRINK IT."

Colliery, which discharges into the Wollangambe River. It's thought to be the most stringent licence ever issued to an Australian coal mine. "In my opinion, this is now the most highly regulated coal mine in the world, operating in an environmentally sensitive location," says Wright.

The Berrima Colliery was added to the suite of mines under Wright's watchful eye when he, PhD student Nakia Belmer and third-year environmental science undergraduate Ben Green began collecting water samples from the Wingecarribee above and below where the Berrima mine drainage enters. Within a few months it was clear that something was wrong.

With each set of samples, the pollution was becoming worse. Acidic mine drainage was increasing and so too was the leaching of heavy metals.

"The most incredible thing was that no one was monitoring it and able to assess its impact until we came along and did our research," Wright says. The existing EPA licence didn't set discharge limits on the metal pollutants coming out of the mine, so the most toxic and dangerous pollutants were unregulated, he says.

And although the agency required the company to measure pollution upstream and downstream, the downstream sampling was about 5km from the discharge – by which point, the pollution was not detectable.

Just before Christmas 2016, Wright met with the EPA, the NSW Department of Resources and Energy and Boral, which owns the Berrima mine, to alert them to the chemical contamination.

Then, in February 2017, Wright's team returned to study the impact on insect life in the river system. "When we got the invertebrate results we realised the ecosystem was really sick... the river below the discharge was dying," Wright says.

BERRIMA COLLIERY

2013
Berrima Colliery closes.

2014
Wright is asked by a Southern Highlands community group to investigate ongoing discharge from the old Berrima Colliery —the NSW EPA also suggests to Wright that the mine is worth investigating.

SEP 2016
Wright and his team begin sampling the chemistry of the mine's discharge into the Wingecarribee River.

DEC 2016
Armed with three months of data Wright meets Boral, EPA and NSW Department of Resources and Energy to show them that the pollution from the mine is far more significant than anyone anticipated.

FEB 2017
Wright's team carries out invertebrate sampling in the water downstream from the discharge; the results reveal that river life is being severely impacted.

MAY-JUL 2017
The invertebrate data triggers another series of meetings with the EPA, Boral and Resources and Energy.

Levels of key indicator organisms were much lower than expected. Mayflies, stoneflies and caddisflies, three groups with nymph or larval stages that develop in river beds, had dropped by 90 per cent in the water immediately downstream from the discharge site compared to the stretch above it.

Boral responded to the report and is evaluating the best way to treat the mine's discharge. Even though the mine is no longer operating, the company has installed a new underground treatment system to capture pollutants in the mine's waste water.

"I'm ecstatically happy," Wright says. "It's the first mine I've heard of in Australia that's shut down and the coal miner is now going back in to fix it."

In fact, Boral is keen for Wright to remain involved and will take him underground at Berrima to show him the treatment system when it's up and running. The company has also provided the team with access to their own records of the mine's water chemistry before and during closure. Combined with the post-closure data, it's allowed the team to look at the process in a way that's never been possible previously anywhere else in the world.

Thanks to the stricter regulation, the river is recovering its health, Wright notes. "The wastes are far less damaging and the river is recovering its ecological health. Our research had a beneficial impact and helped make this happen."

"More than just helping this river recover — sensitive invertebrate animals are returning to once heavily polluted reaches — this case study shows that coal mining can occur in highly sensitive locations and 'tread lightly' on the environment," says Wright. "It also offers the broader community hope: environmental problems can be addressed and things really can get better."

ACCIDENTAL ACTIVIST

When famed US environmental campaigner Erin Brockovich tweeted her approval for what Wright's research had achieved at the Berrima Colliery, Wright acknowledged that he might be seen as an activist.

He's quick to point out that he didn't plan for his career to pan out that way and that he's certainly not opposed to the coal industry.

"I was going to be a dairy or cereal farmer," he recalls. "But I worked on a cotton farm one summer 30 years ago during the second year of my undergraduate degree in agriculture. That changed me – I saw what we were doing to our rivers."

He ended up working for Sydney Water for 20 years before he came across the Canyon Colliery, and the pollution it was pouring into the Grose River in 2002, years after it had closed in 1997.

"It's national park, a declared wild river, declared wilderness area and it was stunning — except for the pollution from this old coal mine," says Wright.

Wright completed his PhD thesis on the old mine through Western Sydney University in 2005, and his path was set.

OCT 2017
The Environmental Protection Authority (EPA) issues a formal notice to Boral to fix the problem.

DEC 2017
Boral plans to begin treatment of the discharge.

2018
Boral establishes a Berrima Colliery Working Group, which meets regularly to discuss progress.

2019
Boral install bulkheads in the mine workings to reduce discharge of drainage from the mine to the Wingecarribee River. Discharge of contamination reduces.

2021
Boral announces that drainage from the mine will be collected and piped to its nearby Berrima Cement Works to stop waste discharge to Wingecarribee River.

One of the best ways to cool your home is to open it up at night.

PROMOTING SIMPLE WAYS TO STAY COOL

Practical suggestions from the community about keeping cool on hot days have been outlined in a free pamphlet.

7 AFFORDABLE AND CLEAN ENERGY

By drawing on community knowledge, researchers at Western Sydney University have produced an informative and accessible pamphlet that outlines simple ways to deal with rising temperatures in the home. With summers predicted to become hotter due to global warming, the pamphlet will prove a valuable resource.

"The pamphlet emerged from a project that we'd done with households in Western Sydney looking at how they respond to the heat and what strategies they employ," says Louise Crabtree-Hayes, a professor at Western's Institute for Culture and Society. "It was really interesting as there was this phenomenal pot of knowledge about dealing with the heat in the community and we wanted to make it more accessible to people."

The practical strategies given in the free pamphlet, which is called *Preparing for the Heat*, are deliberately low-tech and easy to implement. Typical examples include placing potted plants outside windows, having face towels that can be soaked in water, and identifying cooling refuges within five minutes from home. Air conditioning is only mentioned once. "Not everyone has air conditioning or is able to afford to run it if they do," says Crabtree-Hayes. "The suggestions were selected to cause people to think 'These are things around the home I could do to make it a bit cooler on a hot day.'"

Being cooler is not just a matter of comfort; being too hot can induce heat stroke or cause health complications, especially in the more vulnerable such as the elderly and those with pre-existing health conditions.

To enhance its accessibility, the pamphlet is light on words and attractively illustrated. It is being distributed both physically and on a range of websites.

NEED TO KNOW

- Heatwaves pose a considerable health risk to the most vulnerable in the community.
- Western researchers produced a pamphlet describing easy, low-tech ways to stay cool.

‘LIVING LAB’ SHOWCASES SUSTAINABLE NEIGHBOURHOOD

A unique development partnership will help form a transformative innovation precinct.

7 AFFORDABLE AND CLEAN ENERGY

Western Sydney University has entered into a joint partnership with the diversified property group Stockland to create a thriving, mixed-use precinct that will serve the local community near its Penrith campus.

The transformative new precinct, named the Penrith Sustainable Innovation Community (PSIC), presents numerous opportunities to integrate curriculum, University operations and research through co-design, co-creation and co-development of both campus infrastructure and the community.

“This is an exciting opportunity to create a ‘living lab’, bringing together university, industry, and community to showcase a new way of co-creating a sustainable urban precinct,” comments Nicky Morrison, the Professor of planning and Director of the Urban Transformations Research Centre at Western.

Through the project students can potentially take part in areas such as planning, advocacy, project-based learning, and skills development.

Some goals of PSIC include developing sustainable, safe, and accessible transport options, integrating digital technologies into the built environment, incorporating findings of interdisciplinary research on sustainable design and sustainable construction materials, employing climate-sensitive design and creating local skilled jobs.

Importantly, PSIC will contribute to multiple SDGs, helping to maintain Western’s number-one position in the world for its social, ecological, and economic impact, as marked in the Times Higher Education University Impact Rankings in March 2022.

“As global problems have local manifestations, PSIC can act as a testbed to incubate ideas and pilot promising new solutions to real-world challenges,” says Morrison. “We hope that delivering action-oriented outcomes based on exemplary demonstration of research and innovation at PSIC can be replicated in other contexts across the region, metropolitan Sydney, nationally and globally.”

“Planning is now underway,” says Morrison. “The selected living lab initiatives will be informed by our joint innovation and sustainability strategy that is being currently developed.”

NEED TO KNOW

- The Penrith Sustainable Innovation Community (PSIC) is a new precinct being developed by Stockland and Western.
- It will act as a testbed to trial new solutions to real-world challenges.

An artist’s impression of the Penrith Sustainable Innovation Community (PSIC).

WESTERN SYDNEY'S GROWING PROBLEM WITH JOBS

More than 25,000 new jobs will be needed every 18 months for the next two decades to overcome western Sydney's jobs deficit.

8 DECENT WORK AND ECONOMIC GROWTH

"The western Sydney economy, will struggle to deliver quality jobs in the long term," says Phillip O'Neill, Professor of Economic Geography in the School of Social Sciences at Western Sydney University. There is a staggering jobs deficit in the region despite record economic growth in the years leading into the pandemic, he says. A series of reports by O'Neill project the probable outcome over the next two decades if nothing is done to address the issue: 562,000 people leaving the region for work each day with punishingly long commutes, and, as O'Neill puts it, the collapse of the dream of the good life in Sydney's sprawling outer suburbs.

THE PROBLEM IN PARRAMATTA

O'Neill points out that, despite concerted efforts in building up the Parramatta CBD, the number of additional workers seeking professional services employment, including in the public sector, exceeds the growth of jobs in the area. "A genuine CBD is an exporter of jobs — people who don't live in the area are able to come into the area on a daily basis for work, because that area has a surplus of jobs and insufficient workers," he says. Yet Parramatta is growing the other way. "Population growth for Parramatta in the age brackets where people seek employment actually exceeds the growth of jobs."

In contrast, Barangaroo — a recently constructed business, recreation, and residential hub on the western edge of the Sydney CBD — will offer about 25,000 professional services jobs when it is fully completed. Billions of dollars have been spent preparing the area, attracting businesses, and building dedicated public transport and pedestrian access. "Barangaroo is a yardstick for what it takes to build 25,000 jobs," says O'Neill. "To ensure the jobs deficit in western Sydney doesn't worsen by 2040, one Barangaroo's worth of jobs needs to be created in the region every 18 months."

NEED TO KNOW

- The jobs deficit is an ongoing issue in western Sydney.
- 60% of professionals can't find work in the region.
- Existing governmental policies are failing to secure a sustainable economic future.

STUCK IN THE PAST

Part of the jobs problem is that planning in the region has not paid enough attention to the changing demographic profile. "Fifty years ago, western Sydney was one of Australia's major industrial regions," says O'Neill. In 1971, a third of the local workforce had a job in manufacturing. But this proportion fell to 7.8% by 2016. Yet, by 2021, 20% of western Sydney's workforce had become professionals, he says, "a total of 203,000 workers — larger than any other occupational category in the region."

Two things in particular have changed in western Sydney: the manufacturing sector has declined, and the number of young people accessing higher education has greatly increased.

"The take-up rates of higher education in western Sydney have been equal to any industrial metropolitan region in the world," says O'Neill. "To put this in perspective, the growth of professional services workers in western Sydney now exceeds the growth of that pool of workers in Brisbane, Adelaide and Perth combined," he says. However, about 60% of those workers in western Sydney can't find jobs in their home region and need to commute into the city and other areas. "Western Sydney exports the bulk of its young professionals at 6.30am each day, grinding down their energy and enthusiasm, and their family life, on the long commute to the east," he says. The sectors in the region that experienced the highest growth in jobs prior to the COVID-19 pandemic are construction and social assistance, which are highly dependent on population growth. In the wake of the pandemic, however, the construction boom has faltered, and the care sector is characterised by a low-wage, relatively low-skilled workforce with minimal impact on job creation and income growth in the region. Unfortunately, these

sectors will not underpin long-term, sustainable economic betterment for western Sydney. "A 21st century economy requires a highly educated, innovative, creative workforce," says O'Neill.

LOOKING FORWARD

Without substantial shifts in planning strategy, prospects for the region remain a concern. "Existing government polices pay insufficient attention to the long-term jobs problem," says O'Neill. His latest report, *Future Directions*, highlights the need for policies that address three key issues: the ongoing presence of leading firms in the region, the nurture of locally embedded business activities, and the regeneration of the region's historic strategic centres.

"New housing, big item infrastructure and folders full of MOUs for the dream of a western Sydney aerotropolis all have their place," says O'Neill. "But so much more needs to be done."

SUPPORTING CHANGE

Navigating the transition from school to adult life while managing intellectual disability.

10 REDUCED INEQUALITIES

More than four million people in Australia have some form of disability, according to the Bureau of Statistics. The unemployment rate for working-age Australians with disabilities (9.4%) is almost twice that of those without (4.9%).

For example, Bridget, who has an intellectual disability, found it very difficult to transition into employment after she left high school. She wanted to get into childcare, but was not able to receive the help she expected to make her ambition come true. "I don't comprehend properly and I muddle my words," she explains.

She says she went from one adult disability service to another, until she settled at Alive4Life, a community and disability organisation where she is both a client and an employee. At Alive4Life, she gets help with reading and building her self-confidence.

She also supports others. Bridget is part of a five-member advisory group for a Western Sydney University research study funded by the Endeavour Foundation, all of whom are aged 16–25 years old and have an intellectual disability.

This research was funded by the Endeavour Foundation Disability Research Fund.

NEED TO KNOW

- Young people with a disability may fall between the gap during the move from school to employment.
- Policy needs to address this.

The study aimed to understand how young people with intellectual disability experience the transition from school to adult life. Lise Mogensen, a senior lecturer in medical education at Western, is the principal investigator of the study. Her team — including community-child-health specialist and Western medical-education Senior Lecturer, Jenny McDonald, and social work expert Professor Gabrielle Drake — interviewed 27 young people with intellectual disability, and 21 parents and carers across NSW, Queensland and Victoria, to understand their experiences before and after the transition from high school.

Mogensen and the team are now finalising their reports from this study, and have published a companion piece, based on their findings, for *The Conversation*. "We found that transition processes are inconsistent, and young people with intellectual disability are still lacking choice and control in future planning and decision making," she says. "Young people with intellectual disability are at risk of falling through the gaps after leaving school, and for many, paid employment remains a distant dream."

The Australian Government's National Disability Insurance Scheme (NDIS) became fully operational in 2020, with the intention of empowering people with disabilities to have choice and control over the support they receive. "But for many young people with an intellectual disability and their families this idea is far from reality," says Mogensen. "Gaps in systems and services, along with poor cross-sector collaboration, commonly leave many young adults with intellectual disability in a transitional limbo during their thirties, excluding them from leading purposeful lives and contributing meaningfully to their communities."

Mogensen and her colleagues will provide policy makers with evidence about the gaps that still need to be addressed, and they will also identify the necessary factors for good transition processes following school, to enable young adults with intellectual disability to achieve meaningful participation in disability services, training or employment.

CUSTODIANS OF THE ICE

At the southernmost reaches of the globe, five 'Antarctic cities' are discovering a shared identity in relation to a fragile frozen continent.

11 SUSTAINABLE CITIES AND COMMUNITIES

Western Sydney University has led an initiative for five diverse cities to unite around one commonality: their ties to the Antarctic.

Five key cities surround Antarctica and are officially recognised as gateways to the icy continent: Christchurch in New Zealand, Puntas Arenas in Chile, Ushuaia in Argentina, Cape Town in South Africa, and Hobart in Australia.

Professor Juan Francisco Salazar, of Western Sydney University's Institute for Culture and Society and the School of Humanities and Communication Arts, led the Australian Research Council Linkage Project, Antarctic Cities and Global Commons, between 2017 and 2020. The project team included 15 researchers in five countries, and aims to unite these gateway cities as a Southern Ocean rim cooperative network of Antarctic urban hubs.

"We want to think of these five cities as more than thoroughfares on the way to Antarctica, rather as urban centres embodying the values of Antarctica — international co-operation, scientific innovation and environmental protection — as a custodianship network that can learn from and benefit each other," Salazar says.

For example, a survey of 1,659 residents of the cities was designed to help inform policy makers and industry about the economic, ecological, cultural and political nature of

NEED TO KNOW

- Five southern hemisphere cities are gateways to the Antarctic.
- An ARC Linkage project team sought to provde tools to unite these cities into a cooperative network.
- The cities' youth are being recruited to lead the initiative.

This research was supported by the Australian Government through the Australian Research Council.

"WE'RE ENCOURAGING PEOPLE TO THINK CAREFULLY ABOUT CULTURAL COMPONENTS."

the cities' links to Antarctica, says Salazar. For 57% of respondents, fostering environmental stewardship was the leading reason to be linked to Antarctica, for instance.

The survey results will eventually be made into an interactive index hoped to help strengthen each city's ties to the Antarctic on economic, ecological, political and cultural levels, and to each other, overcoming historic separation and rivalries, says Salazar.

In Hobart, his collaborator, Professor Elizabeth Leane, from the College of Arts, Law and Education, University of Tasmania, says magnifying each city's Antarctic ties will require a genuine cultural shift. "We're essentially creating a series of tools for the councils to use from this project. We're encouraging people who are connected with the Antarctic sector to think really carefully about cultural components," Leane says.

A memorandum of understanding was signed in 2009 by city mayors requiring the cities to explore the benefits of collaborative best-practices for Antarctica. However, as Salazar notes, the substantive relationship between these cities remains tenuous. "On many occasions the cities chose to compete for scarce resources and international investments, rather than find ways to cooperate and share resources," he notes.

Thus, many of the team's efforts have focussed on the younger generation to lead a cultural shift. This includes an educational game, Antarctic Futures, a project by Associate Professor Liam Magee, simulating Antarctic policy decisions on a 50-year scale, and the founding of the Antarctic Youth Coalition, a membership network of young advocates that launched in 2020.

Overall, the project aimed to recast these five cities from simply north-serving gateways at a far-flung periphery, into five important capitals with a united focus – custodianship of the Antarctic.

ANTARCTICA IS NEARLY

TWICE

THE LAND SURFACE OF AUSTRALIA,

at 13,661,000 km^2

The Australian Antarctic Territory spans

42%

OF ANTARCTICA

(Right) © VikiVector/Russia/Getty; (Background) © Ruben Earth/Moment/Getty

Gentoo penguins in Neko harbour, Antarctica.

FROM PLASTIC FANTASTIC TO A WASTE QUAGMIRE

Charting the history of plastic packaging could lead to new insights on how to manage the waste it creates.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

From food packaging, to contact lenses and credit cards, plastic is used in almost every aspect of daily life. How did it become such a ubiquitous material in just a few decades?

In her 2015 book *Plastic Water*, about the rise of bottled water, Professor Gay Hawkins, at Western Sydney University's Institute for Culture and Society, investigated the history of plastic packaging and how it has transformed food production, markets and waste streams. Her insights highlight how to develop better strategies for managing plastic waste and reduce our reliance on plastic packaging.

"Like the Iron Age and Bronze Age, the 20th century can be thought of as the Plastics Age," says Hawkins. "It's the material that has defined our culture."

While much research on plastics focusses on documenting and managing its environmental impacts, Hawkins is exploring how plastic became a normal part of everyday life and the factors that shaped our reliance on it.

"Plastic has had an unbelievably profound impact on how we live — and our environment," says Hawkins. "I wanted to understand how it became so popular and the impacts of this new material culture."

To trace the emergence of plastic over the past century, Hawkins delved into the history of the material and how it was promoted to the public. Before 1950, food was predominantly packaged in glass, cardboard, paper or metal. But the development of light and flexible thermoplastics — plastics that can be moulded using heat — heralded a new era of packaging. Fresh fruit and vegetables were covered in cling wrap on polystyrene trays, coffee was served in Styrofoam cups and polyethylene bottles replaced cartons of milk.

With the advent of plastic packaging came various tactics to convince the public of its virtues and life-changing uses. In post-World War II Australia, Hawkins says that the transition to plastic was driven by promotional material from the fast-growing plastics industry.

Ads and articles in newspapers and women's magazines touted plastic as a new 'miracle' material. Cling wrap promised to keep food fresh, and frozen goods sealed in plastic packaging were promoted as convenient and economical.

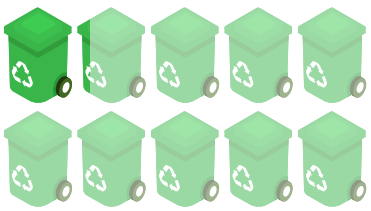
Plastic industry newsletters also began landing on the desks of executives of food production and packaging companies. They promoted plastic as a superior industrial material that would open new pathways for packaging and circulating goods.

"It completely changed our perceptions of food, freshness and cleanliness," says Hawkins. "People thought food was better and safer in plastic, it also changed how we managed waste by promoting single use, disposability and the throwaway culture."

But times have changed. "Most organisations in the world

NEED TO KNOW

- Gay Hawkins is investigating the history of plastic packaging.
- The rise in plastic packaging transformed attitudes towards food and freshness.
- Moving to a circular economy will help fight plastic waste.



IN 2016-17, ONLY ABOUT 12% of waste plastic was recycled in Australia

(Source: National Waste Report 2018, Department of the Environment and Energy)

This research was supported by the Australian Government through the Australian Research Council.

now realise that there is a huge global plastics waste crisis. Many have said it's equivalent to climate change in terms of its environmental impact," says Hawkins. And while plastic remains pervasive in daily life, efforts to reduce its detrimental impacts have gained momentum in recent years. For example, many supermarkets have banned single-use plastic bags and are using reusable pallets in their logistical supply chains. Newer initiatives have also been adopted, such as a return to bulk-food-supply stores which use consumer-supplied containers, and container 'lease' systems for home delivered groceries, similar to the way milk was commonly delivered decades ago.

"We're going back to shopping like our grandparents once shopped," says Hawkins. "Plastic helped to fuel linear economies, which are based on a logic of make-take-waste. But now we're seeing a return to economies that are more circular, that have a return-or-reuse element to them and which aim to extend the life of packaging or avoid it altogether."

Hawkins and her collaborators are now investigating the complex social and logistical innovations that businesses need to undergo to combat plastic waste in a circular economy. "Technical innovations like bio plastics are not the best solution to the plastics waste crisis," she says. "Using less plastic and using it differently is the only solution."

MICROBES AT THE ROOT OF SUSTAINABLE FARMING

The millions of microbes living on plants could help ensure the future of farming.

12 RESPONSIBLE CONSUMPTION AND PRODUCTION

Researchers in Western Sydney are unearthing the critical links between microbes and plants to make farming more sustainable.

Plant roots, stems, leaves, flowers and seeds are home to millions of microbes that increase a plant's nutrient uptake and protect them against pests and diseases. "Plants and microbes have evolved together for millennia," says Professor Brajesh Singh, from Western Sydney University's Hawkesbury Institute for the Environment. "A plant's fitness is closely aligned with its microbiome," he adds.

NEED TO KNOW

- Western researchers are using microbial and biochemical technologies to manipulate crop microbiomes.
- These microbial technologies will help crops grow under stressful situations.
- Some of these microbes increased the productivity of wheat, lettuce and cotton by 35 to 100%.

Singh is developing microbial engineering tools that could sustainably increase agricultural output to produce food for a rapidly increasing population. Food productivity needs to be raised by 70%, in the face of diminishing allocation of land for agriculture.

Farmers have long used pesticide spray or 'seed dressing', in which seeds are coated in pesticides or fungicides to protect them during germination, but these introduce harmful chemicals to the ecosystem. Instead, Singh and his colleagues are using microbial and biochemical technology to manipulate plant and soil microbiomes to create natural microbial communities that help crops grow under stressful conditions such as drought, disease and nutrient deficiencies by promoting more efficient use of resources, and boosting resilience to pests. This will strengthen crops and enhance agricultural production in hostile climates and restore land damaged by the excessive use of chemical fertilisers. "Microbiomes are one of the fastest growing sectors in agriculture," says Singh. "They could eventually be worth as much as the current chemical pesticide market."

Singh's team has been working with Australian plantfood companies, Converte, and Neutrog, that design products for improving soil health. Managing director of Converte, John Ridley, says "This pioneering work on microbiomes is transforming soil and plant systems in ways that could significantly improve food and climate security".

Many microbes are found in a plant's root system.

There is much to be done before the benefits will be realised on the land. "We have developed some microbial products that increase the productivity of wheat, lettuce and cotton in greenhouses by 35 to 100%," says Singh. "We have more recently carried out a limited field experiment with cotton which provided promising results in controlling plant pathogens."

Singh's work has had a number of direct policy outcomes. He is a lead author of the *State of Knowledge of Soil Biodiversity* report by the Food and Agriculture Organization of the United Nations, a work that is cited by a number of UN policies and decisions.

FAST-TRACKING GREEN CITIES

Light rail lines offer an unexpected opportunity to add plants to cities.

Green track will help filter rainfall and reduce flooding, among other benefits.

13 CLIMATE ACTION

Planting vegetation along light rail tracks could add the equivalent of two football fields' worth of green space to the middle of Parramatta, according to Western Sydney University research.

In a viability study commissioned by Transport for NSW, Western researchers found that installing what will be Australia's longest green track will have multiple benefits.

After receiving the team's report, Transport for NSW constructed three separate sections of green track totalling 1.3 kilometres, as part of the Parramatta Light Rail project, which is expected to open in 2023.

Lead researcher Associate Professor Sebastian Pfautsch, from Western's School of Social Sciences, says that replacing hard surfaces such as concrete and bitumen with grasses and groundcover offered a rare opportunity to green Parramatta city, where land is in high demand.

"If you put it together, we are adding more than one hectare of green space in downtown Parramatta," says Pfautsch. "It's amazing."

The team's review of green track around the world found that it can make cities cooler, quieter and improve their air quality, which would be particularly beneficial around areas such as Cumberland Hospital in Westmead.

They also found that greenery along light rail tracks not only provides habitat and biodiversity, it filters and reduces stormwater runoff. The team's report notes that in Parramatta, where annual rainfall is 960 millimetres, between 480–670 litres of stormwater would be retained yearly for each square metre of green track. Any runoff would be filtered by the vegetation and contain fewer pollutants than if it had fallen on hard surfaces such as concrete.

Pfautsch says green tracks increase property values and the viability of businesses along the tracks, such as cafes, as they create pleasant streetscapes. The Parramatta Light Rail program director Mr Anand Thomas adds that the "green track will make the light rail blend in better with the existing local landscapes".

While green track is found all over the world, it has never been tried in a hot, dry climate like that of western Sydney. Pfautsch's review found that green track is suitable in western Sydney if appropriate plant species are used.

"We proposed ground covers which had low mowing, nutrient, and watering requirements," says Vanessa Howe, a PhD student and co-author of the report.

Workers laying green track in Parramatta.

"WE ARE ADDING MORE THAN ONE HECTARE OF GREEN SPACE IN DOWNTOWN PARRAMATTA."

"The species are native to western Sydney and are pretty tolerant to being walked over," she adds.

The team also identified the need for proper irrigation and maintenance. As temperatures in Parramatta may regularly reach the high 40 degrees in the next five to ten years, irrigation will be essential.

"Without regular maintenance it will look ugly and people won't like it," says Pfautsch.

Pfautsch is confident that the Parramatta green track will become a model for the rest of Australia.

"The positives are so overwhelming and the risks are manageable once you have the right strategies. Green track is a good example for progressive, functional urban design," says Pfautsch.

The team's report — together with the first section of green track, based on Australian native species, *Zoysia macrantha* 'Nara' turf, which was laid in February 2022 — was extremely well received. It won two Australian Institute of Landscape Architects (AILA) NSW Awards for research communication and infrastructure as well as the 2022 AILA National Landscape Architecture Award for Infrastructure. "Transport NSW has since broadened some sections of the green track by lining the track bed with shrubs and trees. This maximises the surface area that can absorb stormwater, which can then be used by the shrubs and trees for transpiration cooling," adds Pfautsch. "It's very good green infrastructure design."

NEED TO KNOW

- Western researchers conducted a viability study on green tracks for the Parramatta Light Rail Project.
- After receiving the report, Transport for NSW added 1.3 kilometres of green track.
- This will add more than one hectare of green space in Parramatta.

This research was funded by Transport for NSW.

SEEING THE FOREST THROUGH THE TREES

An accurate model of leaf transpiration will make it easier to predict the effect of climate change on forests.

13 CLIMATE ACTION

How do you mathematically model a tree? It might seem like an odd question, but it is a fundamental challenge facing scientists trying to find out how the environment will respond to a changing climate.

At Western Sydney University's Hawkesbury Institute for the Environment, Professor Belinda Medlyn and colleagues have developed models of forests that can be used to predict how they will be affected by changes in temperature, rainfall and carbon dioxide, and how they will also affect the climate around them.

"We know the climate has already started to change, and that will have a significant impact on the vegetation across the world, but these climate-driven changes are really hard to predict because there are so many different pieces to the puzzle," says Medlyn.

One of those pieces is the question of how much water has transpired, or evaporated, from leaves. For the past few decades, modellers have assumed that the rate of transpiration was essentially the same across all different types of vegetation. But Medlyn took a closer look at the real-world data on water vapour transpiration from leaves, and realised something wasn't right. So, she built a new model of leaf transpiration, which accurately predicts transpiration regardless of species.

Research collaborator, Martin De Kauwe, research fellow at the Climate Change Research Centre at the University of New South Wales, says Medlyn's model was a significant step forward, and is now incorporated into all major models of forest responses. It has also had major implications for understanding how forests respond to extreme climate events such as heat waves, he adds.

"We were able to show from the measurements and her model that evergreen needle-leaf forests have a more conservative water use behaviour, and that basically changes the feedback of water into the atmosphere," he explains. The revised model, incorporating Medlyn's work, suggests that instead of releasing water into the atmosphere during heatwaves, which would lower temperatures, these forests hold on to their water, which could actually make heat waves worse. This means previous models may have underestimated the heat wave intensity across northern Europe, explains De Kauwe.

The policy impact of Medlyn's model has been considerable, for example, it has been incorporated into models contributing to the Coupled Model Intercomparison Project (CMIP6) of the World Climate Research program – the project that provides the climate projections for the Intergovernmental Panel on Climate Change (IPCC) reports. "It's now a textbook standard in the field," says Medlyn.

But Medlyn and the team haven't rested on their laurels, they've built upon the model since its publication in 2015, and are now explicitly considering the trade-offs that govern transpiration and carbon dioxide uptake during drought. "While the original model has been extremely useful in describing 'normal' situations, the development of these new models is proving particularly important for simulating what happens under extreme conditions, particularly identifying the drought and heat thresholds that cause plant mortality," she says.

NEED TO KNOW

- Belinda Medlyn has developed a transpiration model that works across all plant species.
- It is now incorporated into all major models of forest behaviour.
- This work will help researchers understand how forests respond to extreme climate events.

Tarra-Bulga National Park in South Gippsland, Victoria.

This research was supported by the Australian Government through the Australian Research Council.

A TALE OF TWO TURTLES

With the imminent extinction of a rare turtle species, Western Sydney researchers rushed to help. But their studies revealed a problem far more complex than anyone had imagined.

14 LIFE BELOW WATER

It's a scorching Sydney summer day, the mercury nudging 44 degrees Celsius. Inside its artificially cooled greenhouse home, a fist-sized juvenile turtle looks perfectly comfortable, unaware of the conservation conundrum roiling above its scaly head.

This turtle is a hybrid; a blend of two species, each with a sad tale of population decline. But in an unfortunate case of conflict, the survival of each threatened species places the other further under threat.

Research by Western Sydney University ecologist Associate Professor Ricky Spencer and colleagues, is helping save both endangered species of turtle. The intertwined fates of these two Australian species has the potential to instruct conservation approaches dealing with co-existing and competing threatened species not only nationally but internationally.

One parent of the hybrid is a Bellinger River snapping turtle, *Myuchelys georgesi*. Almost every adult of its kind has been wiped out from its only known habitat in the Bellinger River in northern NSW, thanks to a mysterious illness.

The other parent is a Murray River short-necked turtle, *Emydura macquarii*, a species thriving in the Bellinger River, unaffected by the plague. As its name suggests, its original habitat is South Australia's Murray River. No-one knows how it got into the Bellinger, but it was first documented in 1998. Back home, however, the short-necked turtle is under threat, a victim of predation and habitat loss.

'OUR' TURTLE

Locals had once believed that the less common short-necked turtle was 'theirs', unique to the Bellinger River. But when Spencer and colleagues began looking at the genetics of all the river's turtles, they discovered it was the same species of short-necked turtle found in the larger Murray River and rivers inland of the Great Dividing Range. At that time, the short-necked turtle wasn't endangered.

Instead, the Bellinger's more common turtle, the snapping turtle, was found to be unique to the area. The locals readily redirected their loyalty to the snapping turtle and for a while, all was well.

Then in 2015, someone in the local community contacted Spencer saying that large numbers of snapping turtles were dying on the river's banks. Photos sent to him showed a devastating scene. The dead

NEED TO KNOW

- The Bellinger River Snapping Turtle was on the brink of extinction.
- Western intervention saved it.
- Reintroducing the turtle to the river threatens a different endangered turtle.

turtles were covered in ulcers, both on their skin and internally.

"It was 100 per cent mortality, spreading two kilometres upstream per day and just wiping them out."

Spencer had no idea what was causing the symptoms. It could have been bacterial, viral or even some kind of environmental pollutant. He knew he had to act fast. A desperate and massive rescue mission was launched, scouting upstream to find pools where the condition was not yet evident, and removing any healthy turtles.

They found only three unaffected waterholes. "We only got 16 turtles out and only five adult females," he says.

The survivors were transported by car, in damp cotton bags, a full day's drive down Australia's east coast to a purpose-built quarantine facility at Western's Richmond campus. Until more about the problem was known, they couldn't be housed in zoos in case they were carriers of a disease.

Ricky Spencer and Kristen Petrov in the quarantine facility at Western's Richmond campus.

Since then, those turtles have been found to be disease-free, and have relocated to a number of zoos around the country. Taronga Zoo's turtle breeding program has been successful, and there are now 21 Bellinger River snapping turtle hatchlings. "We're still not out of the woods yet, but at least we've brought them back from the brink of extinction and have stabilized population numbers," says Spencer.

The disease remains a mystery. "They call it SCUDS, which is 'subcutaneous ulcerative disease', and underlying that could be a whole range of different bacterial or viral pathogens," Spencer says.

Even more puzzling is the fact that the short-necked turtle appears unaffected, and the disease only seems to kill adult snapping turtles, not juveniles.

While one group of researchers work to identify the pathogen, Western Sydney University PhD student, Kristen Petrov, is examining the differences between the two turtle species in search of a reason why one survived the disease and the other perished. She's using claw samples to work out how the diets of the two species differ, and also looking to see whether the two species overlap in home range and occupy similar habitats. Petrov is studying the immune systems of the turtles to see if there's some vulnerability that might have contributed to the snapping turtle's demise.

"A current hypothesis is perhaps the turtles were stressed in the lead-up to the disease and maybe the river conditions at the time weren't ideal for the prey that they were eating," Petrov says. "If adults and juveniles eat different things, maybe that's why the adults had the most die-off."

This experience has resulted in adopting a different approach to conservation management, Spencer notes. "Instead of waiting for a species to near extinction before acting, we're proactively identifying species in danger," he says. "We're now working to boost the numbers of two other species of turtle."

INVIDIOUS DILEMMA

The captive breeding program has prevented the snapping turtle from becoming extinct. But with the initial crisis over, Spencer and colleagues must decide what to do next.

There are a small number of juvenile snapping turtles still in the Bellinger River who will soon be mature enough to start breeding. A collection of these have been brought to

(Top) © Michael Amendolia

KISSING COUSINS

A species is often defined as a collection of animals that can interbreed and create fertile offspring. However hybridisation, common in wild and captive populations alike, has long clouded this definition. So, zoologists tend to classify species according to their physical features and detailed genetic profile. The fact that the snapping and short-necked turtles can interbreed suggests they are very closely related.

(Top & middle left) © Michael Amendolia; ('in 'Turtle Island') Paul Fahy/Taronga Zoo

Western Sydney University for the eventual creation of a second breeding population in zoos. At the same time, the original 21 captive-bred hatchling snapping turtles could soon be ready for release back into the river.

But the fact that the two resident species interbreed is as much a threat as any disease – over time, hybrids would replace the snapping turtles until the species was no more. There's no modelling to shed light on how long this process will take, but if 50 per cent of the offspring born are hybrids, it's an exponential process.

Meanwhile, the short-necked turtle continues to thrive in the Bellinger River, but in recent years its numbers in its native Murray River have plummeted to the extent that it is now listed as vulnerable in some states.

The short-necked turtles can't be relocated to their original habitat in case they carry the disease with them. But they can't be left where they are because of the hybridisation threat they pose to the snapping turtle's survival. Unfortunately, that may only leave one option: catching and euthanising the short-necked turtles in the Bellinger River.

It's a decision no-one wants to make, but the clock is ticking. "They keep increasing; there'll be new turtles hatching out right now, so it gets harder and harder to eradicate them," Spencer says.

While such a dilemma of two competing, threatened, native species isn't new, Spencer says it's never been quite so extreme as in this case.

"It's going to set precedents for a whole range of other aquatic species if something like this happened elsewhere," he says. "What do you do?"

TURTLE ISLAND LAUNCHED AT GLENBROOK LAGOON

A floating eco habitat designed to provide a safe nesting place for turtles at Glenbrook Lagoon was launched in October 2020.

Turtle Island — a collaboration between Blue Mountains City Council, Western Sydney University and local volunteers — was a pilot project funded by the NSW Premier's Office and council.

"This pilot project has already seen much success, with turtle eggs discovered recently," said Blue Mountains mayor Mark Greenhill.

"Glenbrook Lagoon is home to a number of turtle species, including Eastern Long-neck and Sydney Basin turtles. Turtles have been facing an uncertain future, as foxes destroy 95 per cent of their nests, but the island is providing a refuge."

Leading expert in turtles, Western Sydney University's Dr Ricky Spencer, who helped co-ordinate the project, attended the launch along with council staff, bushcare volunteers and students from St Finbar's Primary School, Glenbrook Primary School and Blue Mountains Grammar.

Local primary students have been involved in environmental studies at Glenbrook Lagoon, including council Bioblitz events, and turtle studies.

"Glenbrook Lagoon is a haven for remnant bushland, it's an active bushcare site and a valued recreation point for the community," said Greenhill.

"Council has an ongoing commitment to restore the ecological condition of Glenbrook Lagoon and the lagoon is now free from major infestations of water weeds which plagued it for many years."

Turtles play an important role in the ecosystem at the lagoon, acting like vacuum cleaners of the water body.

"The lagoon is rich with wildlife — native fish, eels, frogs and a remarkable array of birdlife," said Greenhill. "Water quality in the lagoon is closely monitored by council and officers have put incredible effort into addressing all sources of pollution within the catchment."

Turtle habitats, a predesigned structure that includes plastic tubing, aquatic plants, sand and geotextile, are being installed at locations throughout NSW.

A COOL APPROACH TO LAND MANAGEMENT

Researchers are collaborating with Indigenous people to understand the benefits of controlled 'cool' burning of bushland in natural hazard management.

Aboriginal and Torres Strait Islander peoples should be aware that this story contains the images and names of people who have passed away.

15 LIFE ON LAND

With unprecedented bushfires raging across southeastern Australia in the summer of 2019/20, Australians are all too aware of the continent's intrinsic relationship with fire. Western Sydney University researcher, Dr Jessica Weir is documenting the cultural practices and intimate knowledge that Australian Aboriginal people have with fire to help improve how we manage bushfires.

Weir has learnt from her collaborative work that many Aboriginal people involved in land management engage with fire differently. Fire is understood to be central to living with and respecting Country.

Australia has always had large destructive bushfires, and for tens of thousands of years Aboriginal people have used 'cool burns' to mitigate their impact, as well as to assist plant growth, hunting, protecting species, and accessing areas.

Cool burns are distinct from prescribed burns, in that fires are lit not just for hazard reduction; a range of ecological and cultural considerations go into the choice of where, when and how to set the fire. These fires don't destroy tree canopies, wildlife have time to escape, and by reducing fuel loads they can also protect lives and property from destructive 'hot burn' bushfires.

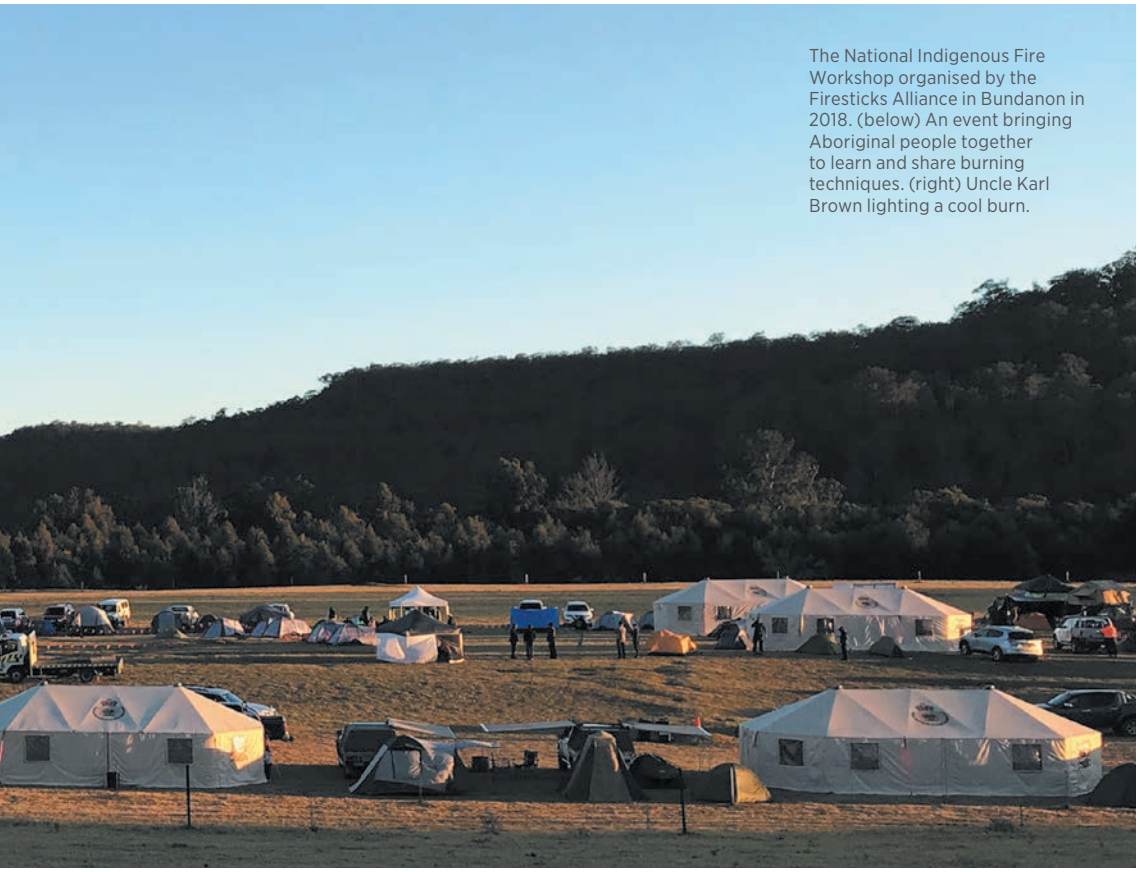
Working with fire on these terms can have local, regional and national benefits as a way to mitigate bushfire risk, create social-ecological spaces, and support Indigenous cultural practices and land management, including support for Indigenous rangers and firefighters.

However, carrying out cool burns presents many challenges, due to historical and contemporary land justice issues, and many conflicting interests vying for a stake in land management, from timber, to farmland, to mining.

"We're very good at debating the science involved in land management, but we need to involve more research about our values, and that's what we're doing at the Institute for Culture and Society. We're looking at what society thinks is normal and appropriate in bushfire risk mitigation," says Weir.

NEED TO KNOW

- Cool burns have been practised by Indigenous people for tens of thousands of years.
- The Bushfire and Natural Hazards CRC is investigating the relationships between hazards, culture, and Indigenous communities.



The National Indigenous Fire Workshop organised by the Firesticks Alliance in Bundanon in 2018. (below) An event bringing Aboriginal people together to learn and share burning techniques. (right) Uncle Karl Brown lighting a cool burn.

COOL VS PRESCRIBED BURNS

The difference between cool burns, and prescribed or controlled burns is the intention and who is setting the fires. Cool or cultural burns are done by Indigenous people for a multitude of reasons including food, access and reduced bushfire risk; whereas hazard reduction burns are intended to reduce risk to properties and lives. Both require permission from relevant fire agencies.

Weir is co-leading a research project with Deakin University, with funding from the Bushfire and Natural Hazards Cooperative Research Centre, that examines the relationship between hazards, culture, and Indigenous communities.

One of several places where cool burns are influencing the fire sector is the Australian Capital Territory, where the ACT Parks and Conservation Service staff carry out a cultural burning program centred on learning from cool burns. "It's about changing industry practices in the ACT," says Weir.

In the ACT Parks and Conservation Service program, the Ngunnawal people, the traditional custodians of Canberra, identify priority areas and then a Ween Bidja (fire boss) lights the fire. "We call them 'the fire boss' because we are in control of the fire, it is not in control of us. Fire is a tool," says Dean Freeman, a Wiradjuri man and Aboriginal Fire Officer from the ACT Parks and Conservation Service.

"You can imagine it was very exciting when we got an elder, Uncle Karl Brown, to light the first match in Canberra in an area which hadn't been lit for 200 years. We are bringing our ancient techniques into the modern world. We also use it to protect our own cultural sites," says Freeman.

"It's extraordinary because it's a community of practice. Indigenous and non-Indigenous fireys working on risk-mitigation together," says Weir.

Weir's qualitative research involves interviewing Indigenous and non-Indigenous government staff involved in the burns and tracking their different assumptions, knowledge and practices they bring to fire management.

In public debates it is sometimes assumed that Aboriginal fire management and other traditions are set in the past and irrelevant to modern Australia. The interviews have revealed further understanding, that these are living traditions, always adapted to contemporary contexts, including bringing in new techniques and new knowledge. "This is a critical gear change in our maturity as a nation," adds Weir.

Weir is exploring how reinstating cultural burning in Canberra can support Indigenous peoples' cultural practices. "It's an opportunity to showcase Indigenous peoples' authority and care with respect to fire and the land." The work has also revealed that if traditional owners are to lead their own fire management, a much greater sharing of land management resources is required.

She views the Canberra project as a success. Rather than being restricted by public sector bureaucracy, she says the ACT cultural burning programme has now entwined itself around the machinery of government in a way that accesses resources and is slowly but surely changing public sector practice.

"Ultimately, it's about continuing to respectfully learn from each other about how to live best in Australia, and how to manage bushfire risk — which is only increasing."

This research was funded by the Bushfire and Natural Hazards Cooperative Research Centre.

PROBIOTIC SOLUTION TO KOALA'S WOES

Crucial work to understand the gut bacteria of koalas could enhance survival rates for this endangered species.

15 LIFE ON LAND

When a koala dubbed Bingara Liz was admitted to the Port Macquarie Koala Hospital, she was in a bad way. Suffering from a severe case of chlamydia, her eyes were red and almost swollen shut. She was put on a course of intravenous and topical antibiotics to treat the infection.

Liz is just one of many koalas (*Phascolarctos cinereus*) treated for chlamydia in wildlife hospitals every year. The Australian Koala Foundation estimates perhaps 20,000 koalas have been treated in facilities such as the Koala Hospital since the mid-1990s. As few as 20% survive their treatment.

"They'll be on the antibiotic and the chlamydia will be starting to clear up, but then the animal crashes," says Dr Michaela Blyton, formerly a research fellow at Western's Hawkesbury Institute for the Environment, who is now based at the University of Queensland. "The assumption has always been that the antibiotic treatment has wiped out their useful gut bacteria and they're not digesting food appropriately. They stop eating and they just go downhill."

Research from Blyton, and her Western Sydney University colleague, Associate Professor Ben Moore, could lead to a new treatment for koalas to counter the harmful effects of the antibiotics, boosting their chance of survival.

Koala faeces being analysed.

NEED TO KNOW

- Researchers have profiled the gut bacteria of koalas.
- Research found that gut bacteria communities can be artificially altered.
- A probiotic treatment for sick koalas could be derived from this work.

With the animal listed as endangered in New South Wales, Queensland and the Australian Capital Territory as of February this year, the survival rate of koala hospital patients is important to the species' success in those states.

Moore and Blyton profiled the diversity, abundance and activity of koala intestinal bacteria revealing an astonishing, complex relationship between koalas, their food and their microbes. They also found that the microbial community of a koala's intestine can be artificially altered.

Moore started down the unusual path of examining koala faeces because he noticed that when koalas ate manna gum leaves (*Eucalyptus viminalis*), their preferred food tree, and stripped them bare, most individuals did not switch to feeding on the less preferred messmate (*E. obliqua*) trees nearby. Moore wondered whether their microbiome played a role.

He and Blyton designed an experiment to test whether koala feeding had any relationship to their gut bacteria. Along with collaborators, they captured koalas from a manna gum forest and kept them for two months, collecting their faeces and running DNA sequencing on it to identify the resident bacterial species and their functions.

By night, the marsupials were given an abundance of messmate leaves; by day, they were offered manna gum to ensure they would still feed. For nine days, the animals were also administered two daily probiotic pills. Some were dosed with the bacteria extracted from the faeces of messmate-eating koalas living in the wild that had been previously caught; others were inoculated with their own manna-gum-conditioned bacterial community.

When Blyton looked at the results of the DNA sequencing, she found that more than 80% of koalas had experienced a shift in their microbiomes due to their messmate diet and probiotic course. "Some shifted a lot, while others shifted a bit — their microbiomes became more similar to those of the messmate-eating donors," she says.

Curiously, the researchers also found that the degree of change in the microbiome determined how much messmate they ate.

"The more the microbiome shifted, the more messmate an animal was willing to eat," says Blyton.

While Bingara Liz survived her experience on antibiotics, many koalas don't. The researchers hope their work could ultimately lead to a koala-specific treatment, practical for regular use, that could help maintain the delicate balance of intestinal flora during and after a course of antibiotics.

In 2019 Blyton and Moore published their findings in *Animal Microbiome*. "There is now wide recognition of

This research was supported by the Australian Government through the Australian Research Council.

the importance of the koala's microbiome to local dietary specialisation and health," says Moore.

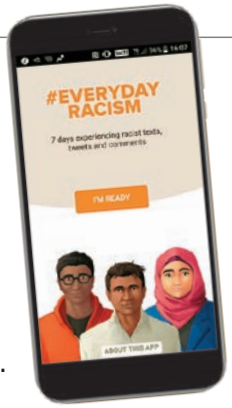
Along with Professor Phil Hugenholtz from the University of Queensland, Moore and Blyton are now exploring the possibilities for koala microbiome manipulation in more depth. "We're hoping to gain a better understanding of which microbes are most important to koalas' digestive health, what their contribution is to the effective digestion of plant fibre, and most importantly, how these microbes can be isolated and preserved for distribution to koala carers throughout Australia," says Moore.

"IT'S IMPORTANT IN TERMS OF CONSERVATION BIOLOGY, NOT JUST HELPING A FEW LITTLE ANIMALS THAT ARE SICK ON THE SIDELINES"

"It's important in terms of conservation biology, not just helping a few little animals that are sick on the sidelines," says Moore. "There are enough seriously threatened koala populations in New South Wales and Queensland where a substantial part of the population is coming into care. Losing those animals from the population is actually dooming the survival of those populations in the wild. We need to get them out of the hospital and back into those wild populations."

STOPPING RACISM IN ITS TRACKS

The Challenging Racism Project combats Islamophobia through innovative multimedia tools.



16 PEACE, JUSTICE AND STRONG INSTITUTIONS

A young woman in a hijab sits on a train. Three teenagers enter the carriage and aggressively ask her why she is wearing a "tea towel". As the abuse continues, the woman's discomfort grows, along with that of the other passengers.

The intensity of the passengers' internal debate between stepping in or turning away is palpable. This type of racial abuse is all too common in Australia. Many onlookers choose not to intervene and instead stand by as witnesses. Research that has been undertaken for more than a decade by the Challenging Racism Project and Professor Kevin Dunn, now Western Sydney University's Pro Vice Chancellor Research, has sought to change that. Notably, the research team created videos using examples of positive action to show how the story could change.

"MUSLIMS IN SYDNEY EXPERIENCE DISCRIMINATION AND VERBAL SLURS AT THREE TIMES THE RATE OF ALL OTHER AUSTRALIANS."

In one video, a young man firmly tells the teenagers to leave her alone. Their response that they are "only having some fun" is rejected by one passenger, and then another. The surly youths exit the carriage after a dismissive "whatever". The woman at the centre of the abuse can breathe again. She turns to the passengers, gives a smile and her heartfelt thanks.

The video campaign, which shows four scenarios of racism, emerged from a project that sought to understand why 'ordinary' people choose to intervene or remain passive in response to racist incidents.

Their research reveals at least three reasons why people don't speak up, says Dunn. "One is they are afraid of becoming a target themselves, another that

(Top) © 2015 All Together Now; background image: Ivcandy/DigitalVision Vectors/Getty

Racial abuse on trains is common in Australia.

they are unsure if the incident was racist, and the third is they say they didn't know what to say or do. We have helped by spreading awareness and disseminating these resources."

Statistics show this belief is well founded. By 2017 the videos had been watched in excess of 10 million times and reached 27 million people.

One survey participant said, "Apart from the fact that [the video] reinforced my belief that there are plenty of peaceful Muslims here in Australia who wish to integrate into our multicultural society, the video taught me that racism is never acceptable!"

The videos have also been used for training in schools and community organisations. Dunn says their research shows the videos change behaviour, with one-third of the 10 million viewers reporting an increased intention to take anti-racism action. It's a figure that even impresses Dunn, yet the team won't stop there.

In a collaboration with the University of Melbourne and Deakin University, the research team have also produced an app called *Everyday Racism* that challenges players to experience a week in the life of a person from a minority group.

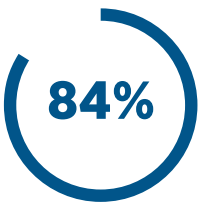
Through the app, participants receive a mixture of SMS and Facebook messages, tweets as well as audio and video recordings and are prompted to choose an action. This is followed by messages that challenge their assumptions and highlight the importance of speaking up against racism.

The app had been downloaded more than 28,000 times with 60 per cent of those who played it recording that they had spoken up against racism since, and almost 98 per cent saying they now saw the importance of taking anti-racist action.

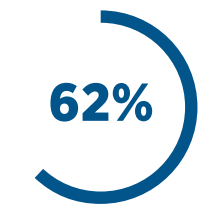
The original *Everyday Racism* app has been recognised globally — it co-won the 2015 UN PEACEapp competition and was named runner-up in the 2014 Intercultural Innovation Award presented by the United Nations Alliance of Civilizations (UNAOC) and the BMW Group.

The success of these and other outreach projects by the team is underpinned by a deep understanding of Australian Muslims. This is best exemplified by Dunn's team's innovative, Australian-first survey of the Sydney Muslim community that recorded the experiences and attitudes of ordinary Muslims.

AN AUSTRALIAN-FIRST SURVEY OF MUSLIMS



Comfortable identifying themselves as Australian



Believe relations between Muslims and non-Muslims are friendly

(Bottom) © monkeybusinessimages/iStock/Getty

NEED TO KNOW

- Islamophobia in Australia has been under researched and under documented.
- Australians do not feel equipped to tackle racism.
- An anti-racism campaign changed the attitude of 3 million+ people.

Dunn says there is a perception — fuelled by the media and some politicians — that Muslims do not integrate well into Australian society or share national values. Yet their 2015 *Resilience and Ordinariness of Australian Muslims* report exposed this as a myth.

They found that Muslims in Sydney had similar outlooks as non-Muslims, especially about big issues such as education and employment.

Despite the survey revealing Muslims in Sydney experience discrimination and verbal slurs at three times the rate of all other Australians, about 62 per cent of those surveyed felt relations between Muslims and non-Muslims were friendly, and 84 per cent are comfortable identifying themselves as Australian.

Like much of Dunn's work, the survey findings were disseminated and reported on widely, and have been used in developing policies on counter-terrorism, policing, and community outreach. For many Australians, however, it was the 2017 SBS documentary, *Is Australia Racist?*, that brought Dunn's research to their attention. Dunn and Blair led a team that measured the extent and variations of racist attitudes in Australia. This SBS-commissioned survey of 6,000 residents informed the documentary, which used hidden cameras to capture the experience of racism through the eyes of those suffering it. Dunn also featured in the documentary to discuss the survey's findings.

Today, Dunn and his colleague Dr Rachel Sharples are working on a longitudinal study being done in collaboration with RMIT that is looking at the impact of socio-economic disadvantage and ethnic diversity on cohesion in communities with significant Islamic populations in both Melbourne and Sydney. Among other things, the group's initial findings suggest that Islamophobia is lower in suburbs with high shares of Muslims than elsewhere in these cities, but that those people with low satisfaction with their income are more Islamophobic.

For Dunn, the constant standout theme is the sense of hope maintained by the Muslim community. "They are hopeful because multiculturalism is an acclaimed goal for this country, so that generates hope," he says. "Muslims in Australia have a reasonable expectation that they won't always be the target because history shows the targets of antipathy change."

Dunn believes the ill feeling toward Muslim Australians is out of kilter and amplified by "some parts of mainstream media" and politicians who have used Islamophobia for their own political gain.

NEED TO KNOW

- Ransomware is a cyberattack where a user's files are made inaccessible until a ransom is paid.
- There are gaps in cybersecurity awareness and education.
- Abubakar Bello is trying to develop proactive defence strategies against such attacks.

DEFENDING AGAINST RANSOMWARE

Understanding how cyberattacks gain access to systems will help protect businesses and individuals.

16 PEACE, JUSTICE AND STRONG INSTITUTIONS

Western Sydney University's Dr Abubakar Bello is developing proactive security and defence strategies to thwart cyber criminals using ransomware.

Bello, a lecturer at Western's School of Social Sciences, explains that ransomware attacks often begin with malicious software encrypting a user's system or personal files, followed by a demand for the victim to pay before they can regain access to the files.

The emerging internet of things (IoT) will make society even vulnerable to hackers, he adds. In future, individual smart appliances could be infected and rendered inoperable. With some ransom demands as little as AUD$20, it may be easier to pay than repair any damaged caused by the criminals.

To dig into this, Bello and his colleagues have conducted interviews with executives and managers from several financial, technology, construction, transportation, education, and health industries looking to uncover the human behavioural factors that are making ransomware so profitable for online thieves. Via these interviews, Bello saw significant gaps in everything from basic knowledge to more sophisticated understandings of how cybercriminals gain access to a user's technology through 'social vectors', such as phishing emails or software automatically downloaded via certain websites. Many interviewees somewhat mistakenly assumed miscreant behaviour was behind breaches, rather than the increasing sophistication of attacks, he says.

As part of the broader defense picture, Bello is linking up with local corporations and government organisations to help provide cybersecurity audits and risk management services. This includes Gridware, an Australian firm focused on cyber defence. Gridware's involvement in mutual projects will include the development of artificial intelligence and machine-learning based monitoring and reporting technologies, as well as incident response and management control frameworks.

While these will be important, Bello thinks user training and awareness plays a major role in defending against the psychological vectors often involved in ransomware attacks. Some of his work has aimed to identify what type of cybersecurity awareness and education programmes are needed to protect against ransomware attacks.

"Traditional education forms didn't work so well," he says. People needed the interactivity of simulations, virtual labs and gamified learning to help them really grasp real-world attack vectors, he explains. "Cyber criminals are constantly changing their tricks for gaining access, so these trainings will also need to constantly adapt," he adds.

"Even in cyber-advanced nations like the US, where several government-sponsored security initiatives encourage secure cyber behaviour, there is a lack of protective measures against current and future methods of ransomware attacks."

IN TELSTRA'S 2018 SECURITY SURVEY

$208,000

was the average cost of downtime due to a ransomware attack

(Infographic) © -VICTOR-/DigitalVision Vectors/Getty; (Top) solarseven/iStock/Getty

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Have you considered a career in research? Have you ever thought about studying a PhD? Do you have skills and experience that you could apply to an impactful research project?

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The Master of Research is a two-stage program designed to provide you with the skills you need to confidently undertake a PhD. Previous research experience is not required.

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The degree involves two years full-time (or equivalent part-time) study.

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If you have completed a substantial research project as part of a previous qualification (such as a Bachelor Honours or Research Masters), you may be eligible for direct entry into the PhD program.

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The Doctor of Philosophy provides you with the opportunity to develop capacity to conduct research independently at a high level of originality and quality. You will uncover new knowledge through discovery, the formulation of theories and the innovative interpretation of previously established ideas.

A PhD qualification opens up a range of new career opportunities. It is also a great way for you to contribute the knowledge and experience you have gained in your existing career and make a positive impact to the research happening in your field of interest.

The PhD degree involves three years full-time (or equivalent part-time) study. Scholarships are available for domestic and international candidates.

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