THE UNIVERSITY of ADELAIDE

Annual Report 2017

WAITE RESEARCH INSTITUTE

adelaide.edu.au/wri

The Peter Waite Legacy and Vision

Peter Waite was a visionary. The son of a Scottish farmer, he immigrated to Australia in 1859 and prospered in the fledging colony of South Australia. Throughout his journey from the pastoral lands of the mid-north of South Australia to the boardroom of the "General and Commission Agent Company", later to become Elders Smith & Co Ltd, Peter Waite embraced and developed innovative and contemporary farming practices.

Peter Waite gifted his homestead, Urrbrae House, and the surrounding property of 299 acres (121 ha) to The University of Adelaide in 1923 for education and research purposes. The Waite Agricultural Research Institute commenced operations on the site in 1924.

In explaining his gift, Peter Waite wrote:

"I have been much influenced by the wonderful work our agriculturalists and pastoralists have accomplished hitherto in the face of the very great odds they have had to meet. With comparatively little scientific training they have placed our wheat, wool and fruit in the highest estimation of the world: our sheep have been bought to such perfection that they are sought after not only by all our sister states, but South Africa. Our agriculture machinery has been found good enough even for Americans to copy; and our farming methods have been accepted by other states as the most up-to date and practical for Australian conditions. We have now reached a point when it behoves us to call science to our aid to a greater extent than hitherto has been done, otherwise we cannot hope to keep in the forefront."

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The Waite at a glance

The Waite is Australia's most recognised and respected agricultural research and teaching brand

The Waite is the largest concentration of agricultural research and teaching expertise in the Southern Hemisphere. Located in the south-eastern suburbs of Adelaide, South Australia, the Campus hosts:

- The University of Adelaide's School of Agriculture, Food and Wine (AFW)
- CSIRO (Agriculture & Food, Land & Water, and Mineral Resources)
- South Australian Research and Development Institute (SARDI)
- Australian Wine Research Institute (AWRI)
- Australian Genome Research Facility (AGRF)
- Australian Grain Technologies Pty Ltd (AGT)
- Arris Pty Ltd
- Food SA
- Urrbrae House Historic Precinct, including the Waite Arboretum

In addition, the Waite hosts the following specialist research centres of national significance:

- Australian Centre for Plant Functional Genomics (ACPFG)
- Australian Plant Phenomics Facility (The Plant Accelerator)
- ARC Centre of Excellence in Plant Cell Walls
- ARC Centre of Excellence in Plant Energy Biology (node)
- ARC Industrial Transformation Training Centre for Innovative Wine Production
- ARC Industrial Transformation Research Hub for Wheat in a Hot, Dry Climate
- FOODplus Research Centre
- Wine Innovation Cluster (WIC)
- The University of Adelaide/Shanghai Jiao Tong University Joint Lab for Plant Science and Breeding
- The Fertiliser Technology Research Centre

Over the last 90+ years, the Waite Campus has developed through the pursuit of excellence in agricultural science and collaboration between the co-located organisations to become:

- Australia's most recognised and respected agricultural research and teaching brand
- A global leader in agriculture, food, wine and natural resources science, exploring and informing critical national and global issues and challenges such as Australian agriculture industry competitiveness, food security, sustainable intensification of agricultural production, food, nutrition and health, advanced agricultural systems, and adaptation to climate variability and change
- An international model of research, development, industry application and teaching through co-location of institutional partners, with capability in whole of value chain approaches from gene discovery to consumer needs
- Renowned for high-quality education and training in agriculture, food and wine through undergraduate and postgraduate coursework and research degree programs
- A leading centre of research capability for grains, plant breeding, soil and wine science and natural resource management within Australia.

15 world-class research organisations and centres

1100 research and technical staff

450+ undergraduate students

220+ postgraduate students

$120+ million research income/ expenditure per annum

$270 million research and teaching infrastructure

A consistent high-impact publication record

Internationally recognised for delivering transformational and high impact agricultural technologies and systems

The WRI aims to contribute solutions to the emerging challenges of global food security and agricultural sustainability by stimulating and supporting internationally-competitive research.

WRI's vision, mission & strategic objectives

Vision

Our vision is to assist the agriculture, food and wine sectors in creating valuable, high-quality products and meeting the challenges of global food security, climate and environmental change, and providing nutritious food for a healthy community.

Mission

Our mission is to deliver world-class advances in plant biology, agricultural production, and wine, food and nutrition sciences to inform and support these sectors and policy makers – for the benefit of consumers and global communities.

Strategic Objectives

Waite Research Excellence

- Support strategic appointments, visitors and partnerships to maximise the opportunities for innovative and significant research at the Waite
- Build key strengths to support the development of research excellence in agriculture, food and wine
- Invest in new research fields and technological innovations with high potential and relevance to agriculture, food and wine
- Attract outstanding research students to ensure future excellence of expertise in agriculture, food and wine
- Enhance interdisciplinary research activity by supporting existing and potential collaborations across the University of Adelaide and Waite Campus partners

Waite Research Innovation

- Support interactions between the University and industry, particularly with the involvement of research students
- Attract relevant and well-resourced local and global agriculture, food and wine industry partners to the Waite Campus to support fundamental and applied research and related infrastructure
- Enhance partnerships that promote the uptake of research outcomes for greater impact and commercialisation

Waite Research Global

- Support international research collaborations for the benefit of the Australian and global agriculture, food and wine sectors
- Extend the capability and capacity of our researchers through targeted global engagement, especially with University of Adelaide priority partners (the University of Nottingham, Shanghai Jiao Tong University and North Carolina State University)
- Encourage and support international exchanges of staff and students to build research excellence, and enhance the scope and scale of global research collaboration

Waite Research Enabled

- Support and promote a culture of mentoring at all levels of career development
- Support future research leaders through targeted development programs and talent renewal initiatives
- Support investment in major and unique research infrastructure and services that attract leading researchers and enable research excellence

Waite Research Engaged

- Communicate the findings, benefits and significance of our research and education initiatives to our full range of stakeholders
- Ensure the research and education at the Waite are visible and widely known for excellence in agriculture, food and wine
- Maintain continuous links with Waite alumni for mutual benefit

WRI's goals, structure and governance

The Waite Research Institute (WRI) was established in 2009/10 to reinvigorate the vision and legacy of Peter Waite and support The University of Adelaide's commitment to agricultural research, development and teaching, and to the Waite precinct. The Waite brand carries an iconic status world-wide that the University wants to ensure remains synonymous with research of the highest quality, focused on innovative solutions for improving agricultural systems.

The WRI supports the University's research in agriculture, food and wine by developing and funding strategically important initiatives and by building research capacity and performance through investment in people and infrastructure.

The co-location of several complementary research organisations such as CSIRO, the AWRI, SARDI and companies including Australia Grain Technologies (AGT) is a unique aspect and strength of the Waite precinct. There are strong collaborative links between these organisations and much of the Campus infrastructure results from co-investment by these partners. Co-location has much to offer, and the WRI has championed the exploration of new opportunities through the establishment of the Waite Strategic Leadership Group and Waite Communicators Group, with members drawn from the leaders and communications staff of all co-located partner organisations.

The WRI has invested its resources in a combination of support for new research initiatives, and targeted support of existing areas of strength. The intention is to drive research activity in new and exciting areas that have national and international appeal.

In pursuing these aims, the WRI has supported research leadership and ECR professional development, equipment and infrastructure, small and large projects of strategic value, salary support of key research staff at various stages, large grant and Centre bids and grant-writing support. The WRI also adds value to the Waite precinct and the internationally-recognised Waite brand by providing a valuable 'front door' service and central coordination point for communications, and by supporting and resourcing a range of initiatives that include shared events, a precinct website, and facilitation of workshops, symposia and meetings that enhance multidisciplinary collaboration.

Increases in the Waite's competitive research grant funding and industry collaborations, publication numbers and HDR completions have all occurred on the WRI's watch, and the Excellence in Research Australia (ERA) rankings for all Waite-based disciplines remain above or well above world-class.

WRI Staff in 2017

The WRI was supported by a small, multi-skilled team of two staff (1.9 FTE) in 2017.

Professor Mike Keller
Director

Ms Carolyn Mitchell
Executive Officer

Mrs Keryn Lapidge
Communications Officer (0.9 FTE)

WRI changes in 2018

Staff changes to the WRI in 2018 include addition of two Deputy Directors and a new Interim Director.

A/Prof Chris Ford

Interim Director

Prof Matt Gilliham

Deputy Director

Prof Andy Lowe

Deputy Director

WRI Goals

In 2017, the WRI's activities continued to be focussed on the broad goals of:

1. Growing the quality of Waite science
2. Enhancing the reputation of the Waite
3. Increasing collaboration across the Waite
4. Developing Waite people for the future

WRI Structure and Governance

In 2017, the WRI's investment decisions were managed by a ten person Research Committee. Convened by the School of AFW Deputy Head (Research) and WRI Deputy Director Professor Matt Gilliham, the Committee met quarterly to assess opportunities and review applications.

The WRI assessed and supported opportunities according to the following criteria:

- for building research excellence and capacity in areas that align with existing and emerging strengths in agriculture, food and wine
- that have strategic value for the School of AFW, the Waite and the University
- that can demonstrate breadth of impact
- that offer value for money through leveraging co-investment
- that deliver tangible returns
- that foster multi-disciplinary efforts to address important problems.

The School of AFW also has financial reporting responsibility for the WRI.

Investment in research that future-proofs and ensures profitable and productive agriculture in the face of limited natural resources, increased costs of energy and inputs, urbanisation and environmental degradation is critical for the planet and our growing population. The agriculture, food and wine sector must meet these challenges against a background of serious climate change impacts such as seasonal instability, severe heat and storm events, warmer regions becoming marginal for some enterprises, and the need to reduce carbon emissions. These complex and inter-dependent issues need the kinds of high quality, integrated and interdisciplinary research that the Waite can provide.

The WRI continues to perform a key enabling role, supporting investment in major and unique research infrastructure and services that attract leading researchers and enable research excellence. In 2017, the WRI co-funded research infrastructure and support costs such as staffing the Waite node of Adelaide Microscopy, the purchase of new equipment for shared use by several research groups and Centres, and providing a $50K contribution towards the University's High Performance Computing capability. This will increase capacity/speed and reduce bottlenecks in data processing and storage in a service that currently supports 700+ researchers with links to 31 University research groups, including several at Waite.

The WRI also plays a key role in boosting research excellence by developing people, investing in development, coaching and mentoring programs for the School's early to mid-career scientists. The 2017 workshops built on the Mentoring Program established in 2014 by the Waite Research Institute/School AFW Research Committee to develop and support early and mid-career researchers.

In addition, the WRI supports the annual School of AFW Research Day and a range of ad hoc symposia, seminars and other events that further the development of the School's young researchers via opportunities to present their work and network with peers and collaborators.

The WRI provides strategic support for individuals, partnerships and Centres in key strength areas to maximise the opportunities for innovative and significant research at the Waite. Our ongoing salary support of Professor Dabing Zhang, who leads the UA-Shanghai Jiao Tong University Joint Laboratory in Plant Science and Breeding, is an example of how this is paying off for the University through high-impact publications, citations and external grant funding.

2017 in Review

In 2017, the Waite Research Institute was involved in the Review of University of Adelaide Research Institutes. Amongst wide-ranging recommendations, the Review highlighted the need for continued investment in, and development of, key research strength areas and emerging fields in response to external needs and opportunities, in alignment with impact and engagement measures. For the WRI, the wider context is an agricultural sector growing in size, diversity and economic importance, especially for SA.

There were some significant Waite gains and achievements during 2017 which the WRI is proud to have supported. Institute members secured more than $28 million in external research funding during the reporting period across a wide range of disciplines, Centres and projects.

Among the largest of these is the successful transition of the ARC Industrial Transformation Training Centre for Innovative Wine Production into a second phase, with a further five years and $4.46m Australian Research Council funding announced in June. An additional $4m in cash and in-kind support came from Centre partners and Wine Australia, making this the funding highlight of the year. The WRI has co-invested in the Training Centre since its establishment in 2013, supporting the professional development of its all-important ECRs and PhD students, who represent the future leaders of the sector.

The Australian Almond Board and the University signed an agreement in August to develop six new almond varieties in the national breeding program based at Waite. Funded by Horticulture Innovation Australia, the program has gone from strength to strength under Dr Michelle Wirthensohn, an early graduate of the WRI's Research Leadership Development Program. Australia is now the second biggest producer of almonds in the world.

The substantial achievements of the FOODplus Research Centre, long supported by the WRI, were celebrated in November as it came to the end of an 8-year term. A few highlights of FOODplus' strong partnerships with industry and commercial outcomes are detailed on page 12.

A number of other large multi-partner projects and centres supported directly or indirectly by the WRI made good progress in 2017. The Wine Australia- funded Barossa Valley terroir project, the AgriFutures Rural R&D for Profit pollination reserves project, the ARC Research Hub for Wheat in a Hot, Dry Climate and the ARC Centre of Excellence for Plant Energy Biology are all producing industry-relevant outcomes and moving agricultural science forward.

The WRI also continued to engage the public in Waite science through its second Waite in the Spotlight event in late September, and develop young agriculture, food and wine researchers through mentoring, publication and career development workshops.

The WRI's key investments, outcomes and activities in 2017 are detailed from page 11.

WRI initiatives and targeted investments have been highly effective in producing significant outcomes for the University's School of Agriculture, Food and Wine (AFW) and the Waite.

A selection of AFW projects funded in 2017

^ Applications that received WRI input/support/investment in development

*** Graduates of the WRI's Research Leadership Development Program**

Reflecting the breadth and diversity of the School of AFW's research and funding sources, the following list is a cross-section of projects/Centres/programs funded in 2017.

Australian Research Council

ARC Industrial Transformation Training Centre for Innovative Wine Production

Primary Investigator: Prof Vladimir Jiranek ***^**
Funding amount: $4,907,172
Project summary: Australia's grape and wine industry generates $4 billion in sales, $2 billion in exports and underpins a $9 billion wine tourism industry. Yet profitability in some areas is low.

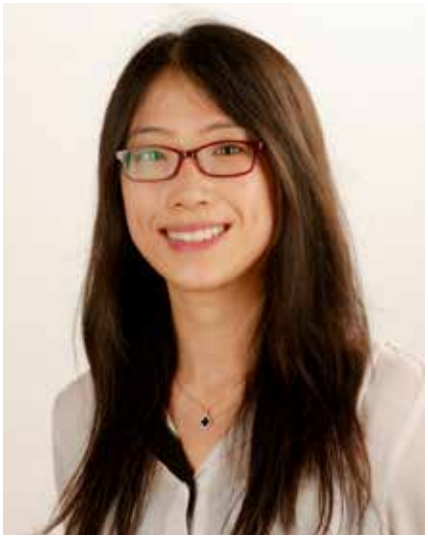
The reasons include challenges to vineyards due to extreme weather events, soil salinity and diseases, while wineries rely on inefficient practices, a low level of technological innovation and high input costs. This bid builds on the training and collaborative excellence of the first ARC Training Centre for Innovative Wine Production to mount a suite of new industry-led projects to deliver outcomes to boost Australia's competitiveness as a supplier of sustainably-produced premium branded wine to the world.

The Centre will tackle new and age-old challenges to wine production through innovative, multi-disciplinary research that delivers wine attracting higher prices and tourists to its origin. New technologies and process efficiencies will reduce environmental impact, drive production costs down and profits and employment up. The work spans viticulture to winemaking taking in aspects of viticultural management, plant biology, genetics, analytical chemistry, grapevine & microbial epigenetics, consumer preference/sensory science, winery process optimisation, ultra-filtration technology, sensing and process control technology.

ARC DECRA Fellowship

Recipient: Dr Haipei Liu**^**
Project title: Improving cereal grain quality using epigenetic regulators
Funding amount: $365,058
Project summary: The project aims to determine the epigenetic regulatory mechanisms that control cereal grain quality and yield under water-deficit and heat stress. Cutting-edge next-generation sequencing will be used to identify key epigenetic regulators – small RNAs – and their functional target genes, which confer superior grain quality to elite genotypes under adverse environments.

Project outcomes will benefit cereal breeding by providing more-tailored screening strategies and superior parental germplasm with enhanced quality and yield. The development of nutritionally improved crops will benefit the Australian cereal industry and export opportunities.



Pictured: Dr Haipei Liu

Grains Research & Development Corporation

Project title: The 10 Genome Wheat Sequencing Consortium (R&D Tender – Improving Crop Yields)
Primary Investigator: Associate Professor Ken Chalmers
Funding amount: $1,294,500
Project summary: The Wheat Ten Genomes project is an international collaboration to *de novo* sequence and assemble a range of wheat varieties from around the world and represents a huge potential resource for genetic and genomic research.

This analysis will be the first to assemble the genomes of multiple individuals to a similar quality and then compare their predicted gene content. This will lead to the construction of the 'pan-genome' of wheat and its characterization is vital to fully understand the genetic control of phenotypes.

As the Australian contribution to this project, GRDC has funded the sequencing of two varieties, *Mace* and *Lancer*. Additionally, a large genetic mapping population derived from crossing these two lines has enabled the anchoring of the physical and genetic maps of these wheat lines to be integrated.

Significant additional resources have also been allocated by GRDC and BioPlatforms Australia to undertake gene annotation within the Mace/Lancer assemblies and a collaboration between a number of University and public sector bioinformatics groups around Australia.

Project title: Pulse Breeding Australia: Faba Bean Breeding
Primary Investigator: Dr Jeff Paull
Funding amount: $1m per year
Project summary: The development of improved varieties of faba bean should result in more reliable production with reduced inputs for disease management and enable the expansion of the crop to new areas of production. This will contribute to GRDC's goal of increasing the component of pulses in cropping systems from seven to 10% in the next 10 years. Faba bean is one of the major cool season food legume crops internationally, with a global production of approximately four million tonnes per annum.

This project will develop new faba bean varieties that have greater yield than current varieties, better adaptation to the major production regions in Australia and improved disease resistance. Improved germplasm incorporating new traits, such as herbicide tolerance, will be developed for the longer-term benefit to the faba bean industry.

South Australian Grains Industry Trust (SAGIT)

Project title: Field testing of sodicity- and salinity-tolerant oat varieties
Primary Investigator: Dr Graham Lyons
Funding amount: $244,131
Project summary: This project builds on a 12-month SAGIT project that found wide genotypic variation in growth of oats under sodic and saline conditions (relative yield, compared to controls, of 31-80%) under controlled conditions. Sodicity tolerance was assessed using our new pot assay, described in Genc *et al New Phytologist* 2016; 210: 145-156. Twenty promising varieties/lines were revealed from 90 screened, and include Troy, Pinnacle, Urano, Coker 227 and Prescott (overseas) and Graza 53, Kangaroo, Wintaroo, Wizard and Forester (Australian). They are now being tested in field trials at Redhill (saline/sodic soil) and Turretfield (control soil) in collaboration with the Waite durum group and the SARDI oat group, respectively. Saline/sodic-tolerant oat varieties will be recommended to farmers, which can extend the range of oat production and increase profitability on marginal land.

Wine Australia

Project title: Understanding the drivers of terroir in the Barossa Valley
Primary Investigator: Associate Professor Cassandra Collins*
Funding amount: $4,351,945
Project summary: Terroir, 'a sense of place', is said to be captured in each bottle of the world's finest wine. Despite being instrumental in selling a wine's story and commanding a price premium; terroir remains an enigmatic concept. To scientifically investigate terroir, trials are being established at national, regional and sub-regional scales. The challenge is to determine the key environmental drivers for fruit style/quality and how they can be better managed to best exhibit the typical style of the region in which they are grown. Wine Australia has funded a large five-year project commencing in 2017 that brings together research expertise from The University of Adelaide, South Australian Research and Development Institute, Australian Wine Research Institute, CSIRO and Charles Sturt University. This study will also build on the Barossa Grounds project that was developed by the Barossa Grape and Wine Association. The project aims to develop strategies for manipulating wine quality in the vineyard to better express terroir and identify marker compounds or chemical profiles for regionality/unique Australian Shiraz wines.

Picture: Field trials of herbicide tolerant faba bean. J Paull.

WRI activities and outcomes in 2017

1 Growing the quality of Waite science

1.1 Collaborative and strategic partnerships

Through targeted co-funding support for initiatives and activities of strategic importance, and supporting the continuously available and well-utilised practical assistance of a professional grant application writer, the WRI continues to invest in and support a range of projects, events, individuals and groups from across the multiple research disciplines of the School of AFW.

Some of the key centres, groups and activities benefiting from WRI funds in 2017 are listed below.

ARC Industrial Transformation Training Centre for Innovative Wine Production

The WRI's co-investment in the ARC Industrial Transformation Training Centre for Innovative Wine Production has assisted in the Centre's successful bid for a further $4.4 million funding over 5 years from the Australian Research Council. Announced in June 2017, this funding will enable the Training Centre for Innovative Wine Production to build on the collaborative excellence of the past four years to mount a program of new industry-led projects to deliver outcomes that boost Australia's competitiveness as a supplier of sustainably-produced premium branded wine.

Australia's grape and wine industry directly employs over 68,000 people, largely in regional areas, generates $4 billion in sales, $2 billion in exports and underpins a $9 billion wine tourism industry. Yet challenges to vineyards due to extreme weather events, soil salinity and diseases, inefficient practices, a low level of technological innovation and high input costs contribute to low profitability in some areas. With this continued funding, the Training Centre for Innovative Wine Production will roll out new projects that will yield outcomes to aid the industry by responding to these challenges.

Opposite Picture: Wide-field fluorescence image of barley root, taken on Nikon Ni-E compound microscope by Dr Gwenda Mayo, Adelaide Microscopy Waite node.

Administered by The University of Adelaide, the Training Centre for Innovative Wine Production collaborating partners include AGRF, AWRI, CSIRO, Charles Sturt University, the NSW Department of Primary Industries, Pernod Ricard Winemakers, VA Filtration (SA), Coonawarra Grape and Wine, Chalmers Wines Australia, E&J Gallo Winery, Wine Australia, Availer and Lallemand Australia.

See *https://www.adelaide.edu.au/tc-iwp/* for more details on the ARC Training Centre.

The Waite node of Adelaide Microscopy

The Waite node of Adelaide Microscopy provides an invaluable local service to Waite researchers. The WRI co-funds the annual costs of Adelaide Microscopy at the Waite, which include a full-time technical officer/supervisor, and has supported the purchase of microscopes and ancillary equipment through past equipment rounds.

Adelaide Microscopy's Waite Facility provides microscopy instrumentation, expertise, technical advice and training in advanced microscopy. The facility provides a conduit to the North Terrace-based Adelaide Microscopy facility, and nationally to NCRIS-funded Australian Microscopy and Microanalysis Research Facilities.

Comprehensive use of the Waite Facility continued in 2017 with a focus on light microscopy and plant specimen preparation. Over 50 students and researchers from the University, co-location partners CSIRO and SARDI, corporate and international visitors accessed the facility. A very broad range of projects and specimen types was seen at the facility, ranging through soil, bacteria, yeast, algae, plants, insects, animals and manufactured materials.

Highlights in 2017 include publication of a paper* by facility user Cristobal Onetto, resulting from a novel correlative technique not previously reported in this field. Confocal work was done at Adelaide Microscopy's Waite Facility and NanoSIMs at UWA's Centre for Microscopy, Characterisation and Analysis; both are NCRIS-funded Australian Microscopy and Microanalysis Research Facilities. Cristobal, supervised by Associate Professor Paul Grbin, worked on glycogen accumulating organisms (GAO), which can cause problems in Australian winery wastewater treatment plants, resulting in turbid effluents under high carbon and nutrient deficient conditions. Incubation of GAO cells under different carbon to nitrogen ratios using ^{13}C acetate and ^{15}N urea, and a combination of fluorescence in situ hybridization (FISH) with confocal microscopy, and Nanoscale secondary ion mass spectrometry (FISH-NanoSIMS), revealed that carbon uptake was enhanced by low nitrogen, and reduced by high nitrogen. Nitrogen dosing is a feasible strategy for controlling excessive growth of these microorganisms in winery wastewater treatment plants.

**C Onetto, K Eales, P Guagliardo, M Kilburn, J Gambetta, P Grbin (2017) Managing the excessive proliferation of glycogen accumulating organisms in industrial activated sludge by nitrogen supplementation: A FISH-NanoSIMS approach Systematic and Applied Microbiology 40, 500–507.*

UA-SJTU Joint Lab in Plant Science and Breeding

The University of Adelaide's priority partnership with Shanghai Jiao Tong University led to the establishment of a Joint Centre in Agriculture and Health in mid-2014. To date, this Centre is primarily embodied in the UA-SJTU Joint Lab in Plant Science and Breeding, which aims to establish a leading position in cereal biology and breeding, and build Australia-China collaboration. The Joint Lab's outputs include high impact papers, multiple collaborations, translational activities, well-trained researchers, and external funding support for a range of projects.

The UA-SJTU Joint Lab in Plant Science and Breeding is substantially supported by the WRI through the half-time appointment of Professor Dabing Zhang. Working primarily on the mechanism behind the development of cereal inflorescences, and molecular control of male fertility in rice, Professor

Zhang's lab also promotes substantial collaboration between UA and SJTU in the agricultural, food and health sciences by organising regular joint workshops between UA and SJTU, the most recent held in Shanghai in mid-2017.

Since its establishment in 2014, the UA-SJTU Joint Lab has produced 24 publications with both UA and SJTU affiliation, and Professor Zhang is now co-supervising seven PhD students and actively collaborating with several AFW researchers. External funding has now been obtained from sources including the Australian Research Council, the Grains Research & Development Corporation, the International Research and Research Training Fund and the European Commission.

FOODplus Research Centre

Throughout 2017, the WRI supported the FOODplus Research Centre, a joint venture between The University of Adelaide and the Healthy Mothers, Babies and Children Theme of the South Australian Health and Medical Research Institute (SAHMRI).

The range of FOODplus' research activity crosses from agriculture into human health and nutrition, with consumer research and commercialisation strands aiding in 'connecting the dots' between paddock and plate, growers and consumers, food and health. FOODplus aims to enhance the nutritional value of food plants and animals through agronomic means and works with food manufacturers to develop these into new food products and prove the clinical value of foods through large scale, high-quality, randomised, controlled trials.

The FOODplus body of work has included conducting the largest nutrition clinical trials ever done in pregnancy and preterm infants; developing a process for stabilising dried blood spots for monitoring a range of nutrient levels, even after storage for long periods at room temperature; and the development of high omega-3 eggs for Solar Eggs and gluten free bread rolls for Riviera Bakery.

In 2017, the FOODplus team had 65 papers published, including a Journal of Allergy and Clinical Immunology article on a randomized controlled trial of early regular egg intake to prevent egg allergy. Significant NH&MRC, industry and NGO grant funding awarded last year will enable the continuation of much of their clinical and health-related work through the SAHMRI Theme.

In 2017, FOODplus also made use of PIRSA Advanced Food Manufacturing grants to:

- develop improved recipes for gluten-free bread with Riviera bakery, adding functional ingredients to Riviera's existing plain gluten-free bread recipe. Bread recipes were trialled at Waite, then those selected were made at the Riviera Bakery. To identify those with the best texture and taste characteristics, these products underwent sensory testing within the company, with selected customers and then with members of the public, including at the 2017 Royal Adelaide Show. Of five functional recipes trialled, two will be put into commercial production in 2018 for sale in supermarkets throughout SA.
- develop and validate probiotic buffalo milk yoghurts in conjunction with a leading SA business. The high fat content of buffalo milk (twice that of cow's milk) makes a yoghurt that is rich in flavour with a creamy mouthfeel, and studies were carried out to devise a process for making a milder thinner set product as well as a full flavour and thicker set yoghurt. Special strains of bacteria starter cultures were used to make the product probiotic. These products will also be launched commercially in mid-2018.

Another project, as part of the Australia-China Grains for Health grant, looked at the effect of high amylose wheat on the growth and metabolism of mice. High amylose wheat has a low glycemic index and high resistant fibre and is believed to improve digestive function, act as a prebiotic for improving the gut microbiome and allow better regulation of blood sugar levels.

Different amounts of the high amylose wheat are being included in a basal diet with a standard wheat and regular rodent chow as control/reference diets. The project is being carried out by PhD student See Meng Lim at SAHMRI with supervision by A/Professor Bev Muhlhausler (AFW), A/Professor Amanda Page and Professor Sarah Robertson (Health Sciences). The results will be very useful in our understanding of the beneficial effects of high amylose grains on metabolism.

ARC Centre of Excellence in Plant Energy Biology

The Adelaide node of the ARC Centre of Excellence in Plant Energy Biology (PEB) has been supported both directly and indirectly by the WRI since 2013. Professor Rachel Burton, formerly node leader with the ARC

PEB's Virtual Plant Cell was a hit with visitors to Science Alive and the University of Adelaide Open Day

Picture: Native furrow bee pollinating canola. M Edwards.

Centre of Excellence in Plant Cell Walls, joined the Centre as a Chief Investigator at the end of the year, bringing her diverse research into dietary fibre, plantago, industrial hemp and biofuels with her into the PEB suite of projects.

PEB research highlights for 2017 included:

- work published by Bo Xu in *New Phytologist* on a 'Calcium-driven immune strategy in plants', which identified a calcium sensor localised in the plasmodesmata (channels between cells), that can regulate flux in the channel to improve a plant's tolerance to bacterial pathogens. Bo Xu also had a paper published in *Cellular and Molecular Life Science* titled 'Structural variations in wheat HKT1:5 underpin differences in sodium transport capacity'.
- Sam Henderson (in collaboration with CSIRO) identified the gene for sodium exclusion in grapevine rootstocks. The gene encodes a protein called HKT1;1 that is active in roots and transports sodium into cells close to xylem vessels. Different allelic variants of HKT1;1 were found to have different sodium transport rates. This work was also published in *New Phytologist*.
- Dr Rakesh David has been involved in a collaboration with The University of Adelaide Library and University of Western Australia to develop a database of plant transporters from a number of species. This work has been supported by the Australian National Data Service and the University DVCR Interdisciplinary Grant scheme. It will result in a web portal that will be available to researchers to obtain genomic, proteomic and phenomic data of plant membrane transporters.

PEB was also involved with The University of Adelaide stand at the Science Alive 2017 outreach event, showcasing the Virtual Plant Cell (developed by Karina Price, PEB, UWA), and mini experiments to look at the impact of salt on plant growth.

ARC Industrial Transformation Research Hub for Wheat in a Hot, Dry Climate

Associate Professor Delphine Fleury, a graduate of the WRI's flagship Research Leadership Development Program, was appointed Director of the ARC Wheat Hub in 2017. The Wheat Hub brings together university based wheat researchers and Australia's three major wheat breeding companies to exploit global diversity for wheat and advanced genomic technologies for faster development of heat and drought tolerant varieties which make better use of nitrogen fertiliser.

Wheat is a major food for many regions around the world. It is the second most produced crop in the world, providing approximately 20% of the daily calories and protein for 4.5 billion people. But drought and heat are two major abiotic stresses which impact wheat production worldwide, causing yield losses of up to 86% and 69% respectively.

Overall, the combination of both high temperature and drought, which frequently occur simultaneously, has a negative, additive impact on plant phenology and physiology, reducing yields. While responses to the two stresses share some common mechanisms, other physiological processes are antagonistic.

Although genetic variation and underlying quantitative trait loci for each individual stress are known, the combination of the two stresses has rarely been studied. Producing wheat varieties with high and stable yields under these environmental stresses is one of the most important aims of breeding.

1.2 Sponsored project outcomes in 2017

The WRI operates at both local and national levels to facilitate, lead, broker, develop and enhance research activities and initiatives that underpin sustainable agricultural productivity and have the potential to deliver transformational changes to the diverse agriculture, food and wine sector.

Outcomes will continue to be geared to improved farming practices, new plant varieties better able to cope with climate change and disease with enhanced yield, greater food security, more nutritious food, improved profitability for farmers, and a decreased environmental footprint for agriculture.

The following cross-section of research projects reflects both the diversity of the research undertaken by WRI members and the range of the WRI's support across multiple disciplines and sectors.

Securing pollination reserves for the agricultural sector

2017 saw the commencement of the Agrifutures Australia Rural R&D for Profit multi-partner program on securing pollination reserves for the future, which is co-supported by the WRI and co-led by Dr Katja Hogendoorn. The University of Adelaide, working with South Australian industry and environmental partners, is helping farmers and growers design and implement native plantings to support bee and other insect populations needed to pollinate their crops and orchards.

This is the first such project in Australia – expected to be a win-win for both growers and biodiversity, with enhanced productivity through improved pollination and increased biodiversity through revegetation with native plants.

Crops such as lucerne, almonds, apples and cherries rely on insect pollinators to pollinate their flowers to produce seeds, nuts or fruit. Canola yield and quality can also be improved with good pollination services.

This project aims to improve the landscape to secure pollinator populations and their crop pollination services. Researchers are mapping the activity of honeybees and native pollinators in areas of revegetation and native vegetation around different crops in South Australia. They will create a short-list of the most useful pollinating species and identify the plants used by the pollinators as sources of pollen and nectar. This will allow strategic choices in

The WRI supports research that is diverse and multi-disciplinary with applied outcomes and real-world impact

revegetation with a selection of the plants that benefit crop pollinators.

This project is of particular importance because insect pollinators are in decline worldwide, due to pesticide use and habitat destruction. The creation of habitat for crop pollinators is part of future-proofing pollination services in preparation for a likely Varroa mite incursion, which has decimated populations of feral honey bees worldwide.

Molecular features of grass allergens and development of biotechnological approaches for allergy prevention

Allergic diseases are characterised by elevated allergen-specific IgE and excessive inflammatory cell responses. Among the reported plant allergens, grass pollen and grain allergens, derived from agriculturally important members of the *Poaceae* family such as rice, wheat and barley, are the most dominant and difficult to prevent.

Although many allergen homologs have been predicted from species such as wheat and timothy grass, fundamental aspects such as the evolution and function of plant pollen allergens remain largely unclear. With the development of genetic engineering and genomics, more primary sequences, functions and structures of plant allergens have been uncovered, and molecular component-based allergen-specific immunotherapies are being developed.

This project aims to provide an update on (i) the distribution and importance of pollen and grain allergens of the *Poaceae* family, (ii) the origin and evolution, and functional aspects of plant pollen allergens, (iii) developments of allergen-specific immunotherapy for pollen allergy using biotechnology and (iv) development of less allergenic plants using genetic engineering techniques.

(*Biotechnology Advances*, 2017. doi: *10.1016/j.biotechadv.2017.05.005*).

Wheat germplasm development for genetic diversity

Crop improvement is dependent upon genetic diversity. The rate of genetic gain in breeding programs can increase by extending the amount or nature of variation available for selection using land races and wild relatives. However, exotic germplasm carries a range of undesirable traits, such as grain shattering, tall plant type, lodging, and low yield potential, that limit their suitability for modern agriculture. Back-crossing to locally adapted varieties and pre-selection for traits is therefore required to ensure that meaningful data can be generated in field trials.

Multiparental schemes such as Nested association mapping (NAM) populations enables the use of exotic germplasm as a resource for the discovery of novel traits and QTL/genes. NAM combine the power of linkage analysis and the precision of association mapping. In NAM population development, founder lines are crossed with the same reference line to develop sets of related mapping progeny. When jointly analysed, NAM populations can provide higher power to detect QTL than in any of the constituent biparental families separately. NAM also have the advantages of association mapping of high diversity and resolution. Many historical recombination events between founders provides fine resolution as in association mapping allowing high resolution to localise QTL.

This program aims to develop a large NAM population using two Australian modern wheat varieties as reference parents and a diverse set of donor lines. Some of the donor lines are known for their tolerance to drought and heat, and nitrogen use efficiency. Backcrossing and early plant culling will avoid undesirable traits and generate populations amenable to modern agronomical practices.

NAM populations are being generated using 75 wheat accessions from the diversity panel from different continents and two Australian varieties, Gladius and Scout, as recurrent parents. Altogether the NAM population will be composed of 100-150 subpopulations, each of 100-200 lines to give a total population of over 10,000 lines.

The NAM population will be genotyped using high-throughput marker technology for genetic mapping. The genetic variation between parental lines is being evaluated for tolerance to drought and heat and for grain protein content. The most variable NAM families will be phenotyped under field conditions to identify QTL for yield and grain protein content in the Australian environment.

Novel crop potential of plantago and hemp

In 2017 work continued to unravel the fundamental biology and the industrial applications of Plantago species which make a seed mucilage, commonly called psyllium in its dry form, relevant to human health and used as a textural agent in food, particularly gluten-free products.

Various methods have been used to screen a gamma-irradiated *Plantago ovata* population and the analysis continued of valuable mutants isolated which display physical and chemical changes in the seed mucilage. The details of how the population was made and screened using a number of different approaches was published in *Frontiers in Plant Science*. A new PhD student commenced studying a variety of other Plantago species including some native to Australia whilst a successful field trial in WA was completed with our industrial partner Dr. Schar.

Also in 2017, work commenced on a joint project with PIRSA, SARDI and the Department of State Development (DSD) to identify industrial hemp cultivars (*Cannabis sativa*) with superior grain characteristics for field trials at two sites in South Australia. Industrial hemp species contain less than

0.5% of the psychoactive cannabinoid THC and produce a highly nutritious grain legalised for human consumption in Australia and New Zealand in November 2017. A set of twenty cultivars with broad geographical pedigrees were screened for oil, polysaccharide and protein contents and the five with the best profiles were selected for planting.

A calcium-driven immune strategy in plants

Higher plants have evolved sophisticated gatekeeper-style channels called plasmodesmata (PDs), which modulate cell-to-cell communication. These microscopic channels create connections between cells and can facilitate the diffusion of metabolites, hormones, small RNAs and proteins responsible for controlling cellular processes and whole plant physiology.

PD pathways can be hijacked by pathogens, including bacteria, viruses and fungi, to aid their spread and this can lead to tissue damage, reduced crop yield and plant death. Previous studies suggested that an increase in cytosolic calcium (Ca^{2+}) concentration could close PD, but the mechanism behind this remained unclear.

In collaboration with the John Innes Centre and RIKEN, PEB researchers identified the first molecular Ca^{2+} sensor that localises to the PD and reduces PD flux, improving a plant's tolerance to bacterial pathogens. The findings suggest a Ca^{2+} regulatory pathway occurs at PDs which contributes to a direct remodelling of the PD size exclusion limit during the mounting of a plant's immune defences.

This research expands our knowledge of plant immunity and suggests a new strategy that could be employed to improve plant performance and the suitability of Australian crops.

(*New Phytologist*, 2017. doi: *10.1111/nph.14599*).

Picture: Plantago ovata. J Phan.

Business development and attracting investment

WRI staff were actively engaged across a wide range of 2017 initiatives to develop business relationships, build the profile of the Waite and attract investment and research partners to the Waite precinct. These included:

- business development meetings with potential industry partners such as Bickfords and Elders
- discussions with grower associations such as Citrus SA about Riverland horticulture training/research needs and internship opportunities
- co-hosting tours and meetings of potential investors and industry partners with government investment attraction agencies such as the SA Department for State Development and Austrade
- support for the development of the University's first Waite Campus Prospectus
- facilitating meetings between University of Adelaide researchers and the CSIRO Innovation Connections business/researcher partnering scheme
- assisting with a collective Waite precinct response to the Federal Government's NCRIS roadmap consultation process
- significant work on a draft business case for the $35m Hickinbotham-Roseworthy Wine Science Laboratory redevelopment and extension

Plant Food Research NZ joined the Waite precinct in 2017, and the WRI also coordinated meetings, tours and seminars with other potential partners including Vivelys.

Picture: WRI visited Nippy's at Waikerie to explore internship opportunities.

2 Enhancing the reputation of the Waite

2.1 Communications and media

In 2017, the WRI's investment and activity in this area ontinued with support of the Waite Campus website (see below) and the publication via this site of approximately 140 stories on Waite research and achievements. Much of this content was shared across a range of channels - including social media, university research blogs, newsletters and partner organisations' communication networks - resulting in a broader reach and direct engagement with audiences across the Waite, wider University and beyond. Articles posted on the website are regularly picked up by other outlets, publications and news channels.

The WRI also developed a Communication Strategy in 2017. This document provides a framework for a more coordinated and integrated cross-campus approach to communication of Waite research.

Waite website, online and social media

The WRI, with support from Arris Pty Ltd, designed and developed the shared Waite website (*www.thewaite.org*), which since 2016 has provided a streamlined and comprehensive online portal to the Waite research precinct. The WRI continues to resource and maintain this website on behalf of the campus partners, and its high quality content has seen increasing use of the site as an agricultural science resource by media outlets, government agencies and the wider University community. Site usage has steadily increased with total pageviews nearly double that of 2016 and *Weekly Alert* subscription numbers up by 140% in 2017. The site has evolved to include new features, for example, an online interface for requests and bookings to the *Why Waite?* school outreach program.

The site offers an overview of the Waite's history and key features, contact information and details for all the organisations and centres based at the Waite, a cross-institutional capability directory, a list of user-pays services and facilities and prospective student and visitor information. As well as providing a landing place for a wide range of external stakeholders, the site is also designed to be a useful resource to staff and students, with a news feed, campus notices, employment opportunities and a shared events calendar.

Instagram was added to the active social media platforms in the @waiteresearch stable, with follower and engagement numbers across all platforms increasing from 2016 levels.

Picture: Prof Mike Keller with Andrew 'Cosi' Costello

South Aussie with Cosi

The segment filmed in October 2016 for the popular Channel 9 program *South Aussie with Cosi* aired in April 2017 and was repeated later in the year. The history of the campus and the Waite bequest, the Waite as a world-class agricultural research precinct and teaching and learning centre, and collaboration across the campus partners were key focus points. Feedback from the segment has been extremely positive and has resulted in an increase in visitors to the campus, including to Urrbrae House and the Waite Historic Precinct. The full segment is available to view at the Waite Research YouTube channel *www.youtube.com/WaiteResearch/*.

Waite Communicators group

The WRI convenes the Waite Communicators Group, comprising media, communications and marketing personnel from all the Waite partner organisations. Members of this Group have contributed significantly to improvements during the last few years in the quality and flow of information between the organisations at the Waite. The Group has overlapping interests in events, media liaison, high-profile visitors to the Campus, science communication, publications and display materials. They have made progress in linking various websites and the consistency of online content, as well as developing ideas for shared resourcing of activities.

In 2017, members of this Group engaged in:

- Discussions around the organisation of the large Waite Festival public event (last run in 2006);
- Waite in the Spotlight event planning and development;
- Waite website content and research story contributions;
- Campus tours/activities/events updates and sharing of relevant information;
- Opportunities to develop joint outreach offerings (such as a structured work experience program) and marketing materials.

'The Waite' newsletter

To better reach the Waite's large range and number of external stakeholders, including alumni, staff of relevant organisations, government departments, funding bodies and primary producers, and keep them up to date with all things Waite, a quarterly School of AFW newsletter was established in early 2015. 'The Waite' newsletter incorporates news items from across the campus partners and captures the 'flavour' of the wider Waite precinct. The publication has been well received and its circulation (500 direct recipients, plus several hundred more staff and members of various associations and organisations) continues to grow. The newsletter is produced and disseminated by the WRI.

2.2 Awards and Honours

Awards and recognition of AFW researchers and academics in 2017 included the following:

**Graduates of the WRI's Research Leadership Development Program (see section 4.1).*

Picture: Dr Sunita Ramesh

Dr Vanessa Melino and **Dr Sunita Ramesh*** were among 10 recipients of the 2017 University of Adelaide Women's Research Excellence Awards.

Professor Rachel Burton* was among the first 30 'Superstars of STEM', a new national program recognising female scientists and technologists. She was also named a finalist in the 2017 SA Science Excellence Awards in the Unsung Hero of SA Science category.

Picture: Professor Rachel Burton

Dr Jennifer Gardner was awarded a Medal (OAM) of the Order of Australia for service to conservation and the environment. Dr Gardner was Curator of the Waite Arboretum for more than 30 years during which time she has significantly increased the collection with more than 2200 trees planted. She retired in February 2017.

Emeritus Professor Geoff Fincher was named Officer of the Order of Australia in the General Division (AO). Professor Fincher was recognised for distinguished service to science, and to education, in the area of plant genomics, as an academic, researcher and administrator, through scientific advisory roles, and to international professional societies.

Dr Jay Bose*, a DECRA Fellow with the ARC Centre of Excellence in Plant Energy Biology, was named a 2017 South Australian Young Tall Poppy.

Dr Caitlin Byrt* won the GRDC Science and Innovation Award for Young People in Agriculture, Fisheries and Forestry and a Winnovation Award from the Australian Institute of Policy and Science.

Dr Stephanie Watts-Williams was awarded the Edith Dornwell ECR Excellence Order of Merit from the Faculty of Sciences, Roger Hill Travel Award and ECR International Travel Award.

Professor Matt Gilliham* was awarded the Mid-Career Researcher of the Year from the Faculty of Sciences and appointed to the role of Deputy Head of School (Research).

Picture: Professor Eileen Scott

Professor Eileen Scott was named the Workplace Champion of Change winner in the Australian Women of Wine Awards 2017. This award recognises those who have provided outstanding support and advocacy for women in the industry and/or have been instrumental in implementing female friendly work practices. **Associate Professor Kerry Wilkinson*** and **Dr Renata Ristic*** were finalists in the Researcher of the Year category.

2.3 Campus tours, events and visits

Given the large number of organisations, centres and facilities co-located at the unique and beautiful Waite precinct, and the critical mass in plant, wine, natural resource management and agricultural research they represent, the Waite receives hundreds of visitors each year, from secondary school students to diplomats and international researchers and business leaders.

The WRI continued to provide a 'front door' service to the Waite precinct in 2017, planning and hosting many tours of the unique facilities located here in collaboration with the Waite partner institutions. This activity supports the development of new collaborative relationships with national and international researchers and institutions.

During 2017, the WRI hosted, facilitated and/or coordinated Waite tours and meetings for around 400 visitors, including the following:

- A group of 1967 Ag Science alumni toured the Waite as part of their Jubilee reunion celebration;
- Diplomats and senior Government officials from Australia, Afghanistan, Egypt, Indonesia, Italy, China, the EU, New Zealand, Fiji, Morocco and Brunei;
- University leaders from the US, the UK and China;
- Study tour visits for numerous researchers and practitioners, including two Argentinian viticulture groups;
- A site visit for an Adelaide-hosted national conference on controlled cropping

Visits like these form a key part of the WRI's outreach and engagement activity on behalf of the University and the Waite precinct partners.

Picture: Alumni from the Ag Science class of 1967 visited the Waite in October

Waite in the Spotlight

The largest public engagement of the year was Waite in the Spotlight, which ran for a second time in late September, featuring speakers from CSIRO, the Australian Wine Research Institute, SARDI and The University of Adelaide on topics as diverse as wine mouthfeel, dietary fibre, food provenance, insecticide resistance and gene editing. All were framed by the event theme of 'solutions through science'.

Held at Lirra Lirra on Waite Road, the event attracted a capacity audience of 180 to hear the short talks, which were delivered in the TEDx style.

The resulting short videos were uploaded to the Waite website and to the WRI YouTube channel, giving the event a much longer and wider reach than most. The videos can be seen at: *www.thewaite.org/waite-in-the-spotlight-2017/.*

Picture: a capacity audience attended Waite in the Spotlight 2017

Other events

Other events hosted, coordinated, supported or sponsored by the WRI on (and off) campus in 2017 included the following:

- PIRSA and the WRI co-hosted an **industry briefing by the Australian Export Grains Innovation Centre** based on research conducted in key markets across south-east Asia.
- To coincide with the July visit of London-based Professor Barry Smith, a philosopher of language and mind specialising in the area of multisensory perceptions of flavour, the WRI and School of AFW hosted a special **Wine and Sound** public event at Urrbrae House. This consisted of an experiment led by Jo Bursynska, a sonic artist with a passion for wine now combining these interests in her PhD studies. Participants tasted a series of five wines as they listened to sounds of different timbre. Following a summary of the results, Jo, Barry Smith and University of Adelaide's wine sensory group leader Sue Bastian joined forces for a fascinating panel discussion. Members of the public with an interest in wine science, winemakers, University staff and HDR students were present.
- A public lecture by Professor Oded Shosoyev, an Israeli expert on bio-inspired nanocomposite materials, was held at the Waite's Charles Hawker Conference Centre as part of the 2017 **Open State** program run across South Australia.
- The WRI was a major sponsor of the inaugural **Urban Food Production Workshop,** held at the Royal Agricultural Society Showgrounds in October and hosted by the SA Division of the Ag Institute Australia.
- The School of AFW / ARC Wheat Hub ran a joint display at the Golden Grains Pavilion at the **Royal Adelaide Show** in September. A major outreach activity for the School of AFW each year, the stand is run by staff and HDR students volunteering their time and energy to engage with the public on the importance and breadth of agricultural science.
- The annual **School of AFW Research Day**, held in early December at the Adelaide Hills Convention Centre for 230+ staff and students, showcased the industry engagement and interdisciplinary collaborations that are a feature of the School's research, and celebrated 2017 successes.

Agriculture, Food & Wine Showcase – Adelaide Convention Bureau

Approximately 65 participants of the Adelaide Convention Bureau's South Australian Agriculture, Food and Wine Showcase visited the Waite in May 2017. They included executives of key national and international associations aligned with South Australia's primary industry focus areas, and South Australian industry representatives, researchers and influencers.

The objective of the Showcase was to promote the outstanding strengths of South Australia's agriculture, food and wine production and innovation credentials in order to position Adelaide as a destination of choice for global conventions from these sectors.

The group's Waite visit began with a lunch at Urrbrae House (pictured) featuring quality South Australian produce. Dean of the Waite, Professor Mike Keller then welcomed the group and introduced key speakers to provide an overview of the scope and diversity of the excellent Ag, Food and Wine research being undertaken across the Waite Research Precinct and South Australia.

Speakers included Professor Rachel Ankeny, Professor Diane Mather, Professor John Williams, Dr Georgios Tsiminis, Professor Randy Stringer (University of Adelaide), Dr Liz Waters (Wine Australia), Dr Steve Lapidge (PIRSA), Dr Tim Muster (CSIRO). Professor Rachel Burton had also addressed the group earlier in the morning at the official breakfast at the Adelaide Convention Centre.

A tour of the Plant Accelerator and Waite winery concluded the visit. The feedback from the group was overwhelmingly positive with many commenting on how much they appreciated the opportunity to visit the Waite and learn more about the excellent research in our state.

The Adelaide Convention Bureau South Australian Agriculture, Food and Wine Showcase was supported by the WRI.

3 Increasing collaboration across the Waite

The WRI continued to play a key role in increasing and enhancing collaboration at the Waite Campus and beyond during 2017

Picture: The Wine Innovation Central (WIC) building

3.1 Shared investment, infrastructure and activities with Waite partners

Providing a central coordination and communication point for the Waite partner organisations on a wide range of matters, including developing a shared communication strategy, collating relevant organisational data and coordinating responses to external opportunities, the WRI has become an invaluable part of the fabric of the precinct.

One of the major benefits arising from the unique co-location of several complementary R&D organisations at the Waite is the ability to share resources and co-invest in infrastructure (such as the WIC Building), people and technology to mutual benefit with reduced cost and duplication.

Some examples of shared initiatives and activities facilitated and supported by the WRI during 2017 are:

- The development of a business case to support a forthcoming bid for expansion and redevelopment of the Waite winery. The winery is the home of WIC winemaking services, a joint venture between the University and the Australian Wine Research Institute, and is heavily used by researchers from across the campus;
- The resourcing and management of the Waite website, *www.thewaite.org*;
- The Waite in the Spotlight event, which aims to showcase the breadth and quality of the research across the precinct for the widest possible audience, as well as communicate why agricultural science is important;
- The coordination and hosting of regular tailored visits to the Waite by external stakeholders and VIPs; the WRI works closely with relevant staff at the Waite partner institutions' to incorporate their facilities and personnel in these tours for maximum exposure, impact and efficiency;
- Support of the University's Food Innovation Theme strategy development workshops held at Waite, involving researchers from across the University;
- Co-investment in the Waite node of Adelaide Microscopy, which is available to all researchers across the campus, and in the High Performance Computing upgrade for the University, which will particularly benefit researchers generating and processing large amounts of data;
- Facilitating and supporting the Waite Strategic Leadership Group (see 3.2) and the Waite Communicators Group;
- Sponsoring and organising a range of regular and ad hoc activities that are of mutual benefit to the Waite partners or which build trust, communication, networking, a collegiate atmosphere and shared interests. Examples include the annual Peter Waite Day event (see 3.3) and seminars organised around eminent visiting scientists.
- The development of a shared communication strategy for the Waite.

Picture: Egyptian Ambassador His Excellency Mr Mohamed Khairat speaking with Dr Trevor Garnett at the Plant Accelerator

3.2 Waite Strategic Leadership Group

The Waite Strategic Leadership Group is a consultative and advisory group comprising the leaders of the Waite organisations. Meeting quarterly, it aims to foster a shared strategic direction for collaborative research activities at the Waite Campus. The Group's goal is to identify emerging opportunities and ensure that the Waite organisations are working together to deliver on them, whilst building capacity for step improvements in Australian agriculture.

The WRI continues to facilitate and support the activities of the Waite Strategic Leadership Group through the provision of secretariat services and the funding and coordination of shared campus initiatives such as the Waite website.

3.3 Peter Waite Day - Building the Campus Community

Peter Waite Day is an informal campus community-building and networking exercise that coincides with the anniversary of Peter Waite's birthday on 9 May each year. Peter Waite's generous bequest to The University of Adelaide for the purpose of agricultural research and education and the legacy of his foresight embodied in the Waite Campus today are celebrated and remembered on this occasion each year.

Held in picturesque locations around the Campus, this WRI-sponsored annual networking event has become a highlight of the Waite calendar, enjoyed by an average of 140 staff from across the Waite partner organisations and featuring a fiercely-contested knockout bocce tournament.

In 2017, Peter Waite Day was held in the Urrbrae House gardens, with 12 teams competing for the Peter Waite Bocce Trophy. The final was played out in fading light with the Building 20 Bullies unable to overcome the Fertiliser Mafia from the School of AFW Soils group, who successfully defended their title from 2016.

The Bocce Chicka Bow Wow team from the AFW School Office, complete with feather boas and long gloves, took home the prize for best team name/costume.

Picture: Peter Waite Day 2017

4 Developing Waite people for the future

The WRI has invested heavily in the leadership training and mentoring of the School of AFW's early to mid-career researchers since 2011, and continues to make the area of people development a priority. In addition to the flagship Research Leadership Development Program, developed by the WRI in conjunction with executive coach Karilyn Fazio of the Impetus Team, the WRI also funds short professional development workshops delivered each year on a range of relevant topics, open to researchers and HDR students from across the School.

Picture: Associate Professor Matthew Tucker

4.1 Targeted Support of Early to Mid-Career Researchers

In 2017, Dr Maria Gardiner ran the ThinkWell Development & Peer Mentoring Program (*www.ithinkwell.com.au*). Twelve early- and mid-career researchers were part of the five-session program which included access to the iThinkWell Online Publication Productivity Program. Topics covered in the five workshops included Turbocharge your Writing, Time for Research, Planning your Research Career, The Strategic Researcher, Alternative Grant Funding, Goal follow-up and Collaborations. In addition to content and coaching from Dr Gardiner, Professor Rachel Burton assisted in delivering the session on securing grant funding.

At the end of the year-long program, participants reported they had been able to produce or increase their publications, submit more grant applications as a Principal Investigator, and develop a 3-5 year career plan. Participants also talked about feeling more supported and having better strategies for managing workload.

Past graduates of the WRI's Research Leadership Development Program are now prominently and regularly featuring in promotion rounds, grant successes, high-impact publication results, media and industry engagement activities and awards.

The program's objective was to increase and foster the leadership skills, behaviours and personal ambitions of the participants.

The full benefits of these investments in individuals often take time to be fully realised, but several members of the early cohorts to undertake this program demonstrated dramatic improvement and accelerated achievement across a range of areas within 12 months – and these benefits are still unfolding. The School of AFW and the Waite more broadly are reaping the rewards of investment in this younger generation of researchers.

Some of the career developments and highlights for graduates of the program in 2017 included:

- **Dr Jayakumar Bose** was promoted to Research Fellow level B at the end of 2017, and **Dr Delphine Fleury** and **Dr Stuart Roy** were both promoted to Associate Professor.
- **Dr Caitlin Byrt** was the recipient of the GRDC Award at the 2017 Science and Innovation Awards for Young People in Agriculture, Fisheries and Forestry and a University of Adelaide Research Fellowship. Caitlin also won the 2017 Winnovation Award in the Science category.
- **Professor Rachel Burton** was among 30 female scientists and technologists named the first Superstars of STEM - ready to smash stereotypes and forge a new generation of role models for young women and girls. Rachel was also named a finalist in the 2017 SA Science Excellence Awards in the Unsung Hero of South Australian Science category.
- **Dr Jayakumar Bose** was named a 2017 South Australian Tall Poppy in recognition of his work at the ARC Centre of Excellence in Plant Energy Biology, as well as his earlier scientific endeavours.
- **Professor Matt Gilliham** was appointed Deputy Head of School (Research), in the School of AFW. Matt was also named winner of the 2017 Faculty of Sciences Mid-Career Research Excellence Award and also secured $1.3 million from the GRDC for grains research infrastructure.
- **Dr Richard Muhlack** won a Faculty of Sciences Excellence in Teaching Award.
- **Dr Michelle Wirthensohn** recieved funding under Adelaide Enterprise's Commercial Accelerator Scheme. This follws her 2016 SA Science Excellence Award for Research Collaboration.
- **Associate Professor Mattew Tucker** secured ARC Discovery grant funding for barley research.
- Centre Director **Professor Vladimir Jiranek** welcomed $4.46 million funding under the ARC Industrial Transformation Research Program for a new five year Training Centre for Innovative Wine Production.

Picture: Dr Michelle Wirthensohn

WRI and the Waite partnerships

The Waite Research Institute keeps alive the vision of Peter Waite by supporting the collective interests of the Waite Precinct organisations. The Waite is unique in the number of non-University research partners co-located there. These partners include Federal and State government agencies as well as national research centres and industry-funded organisations such as the Australian Wine Research Institute.

Some partners have been on the campus for many decades but, irrespective of their period of residency, all have added greatly to the richness of the research environment. They have co-invested in buildings and other infrastructure and have formed effective collaborative relationships with each other. The Wine Innovation Cluster is a recent example of the latter but there are also numerous bilateral links.

The co-location model that epitomises the Waite Precinct as been widely emulated and has helped maintain the reputation of the campus, and therefore the University, as the leading academic agricultural research institution in Australia.

University partners

THE UNIVERSITY of ADELAIDE

The School of Agriculture, Food & Wine (AFW)

https://agwine.adelaide.edu.au/

LOCATION: Ag, Food and Wine Building Hartley Grove, Waite Campus, Urrbrae

The School of Agriculture, Food & Wine (AFW) is one of four Schools within the Faculty of Sciences at The University of Adelaide. The School is a world-class concentration of scientific research, education and product-conferring capability, the centrepiece of the Southern Hemisphere's largest collection of expertise in plant genomics, crop improvement, sustainable agriculture, animal science, dry land farming, horticulture, viticulture, oenology, wine business and food and health.

The School comprises more than 220 research active staff, and several hundred postgraduate and undergraduate students move through the School's suite of degrees each year.

The School is organised into three departments – Agricultural Science, Plant Science and Food & Wine Science – and incorporates several research groups, including:

- Farming Systems
- Food & Nutrition
- Plant Breeding & Genetics
- Plant Protection
- Plant Physiology, Viticulture & Horticulture
- Soil Science
- Wine Science
- Biometry

The School of Agriculture, Food and Wine hosts a number of specialist research centres and entities:

FOODplus RESEARCH CENTRE

FOODplus Research Centre

www.adelaide.edu.au/foodplus

LOCATION: Waite Main Building, Waite Road, Waite Campus, Urrbrae

The FOODplus Research Centre, a unit within the School of Agriculture, Food and Wine, is a joint venture between the University of Adelaide and the South Australian Health and Medical Research Institute (SAHMRI), and has research programs in human health food and nutrition with a particular focus on young families.

FOODplus aims to enhance the nutritional value of food plants and animals through agronomic means and works with food manufacturers to develop these into new food products and prove the clinical value of foods through large scale, high-quality, randomised, controlled trials.

ACPFG
AUSTRALIAN CENTRE FOR PLANT FUNCTIONAL GENOMICS

Australian Centre for Plant Functional Genomics (ACPFG)

www.acpfg.com.au

LOCATION: Plant Genomics Centre, Hartley Grove, Waite Campus, Urrbrae

The Australian Centre for Plant Functional Genomics Pty Ltd (ACPFG) works on delivering yield and yield stability to Australian breeders and growers in wheat and barley with a focus on yield loss due to environmental stresses. The company has a number of research projects including a longstanding research collaboration with DuPont Pioneer. The Centre s co-located with the University of Adelaide's ARC Industrial Transformation Research Hub on Wheat in a Hot and Dry Climate which is jointly funded by ARC and GRDC with strong industry participation by Australian breeding companies.

Plant Cell Walls
ARC Centre of Excellence

ARC Centre of Excellence in Plant Cell Walls (PCW)

www.plantcellwalls.org.au

LOCATION: Level 4, WIC Building, cnr Paratoo Road and Hartley Grove, Waite Campus, Urrbrae

The ARC Centre of Excellence in Plant Cell Walls, established in 2011, is a seven-year collaboration between the Universities of Adelaide, Melbourne and Queensland in partnership with numerous domestic and international institutions. The Centre is hosted by the University of Adelaide at its Waite Campus and has nodes at both Melbourne and Queensland Universities.

The Centre's mission is to advance the fundamental scientific understanding of plant cell wall biology with particular focus on grasses and cereals. The overarching aim of the Centre is to understand how plants regulate the synthesis, assembly, re-modelling and degradation of their cell walls during normal development and in response to the environment. This fundamental knowledge, considered a 'holy grail' in Plant Sciences, is linked with socially, environmentally and commercially important applications in areas such as food security, human health, and biomass utilisation for renewable energy production.

The Centre activities are integrated in three interconnected programs underpinned by state-of-the-art platform technologies, implemented and made available across all three geographic nodes to maximise synergistic interactions and outputs not be possible through individual 'traditional' research groups.

APPF
Australian Plant Phenomics Facility

Australian Plant Phenomics Facility (APPF) - The Plant Accelerator

www.plantphenomics.org.au

LOCATION: The Plant Accelerator, Hartley Grove, Waite Campus, Urrbrae

The Plant Accelerator, a national facility established under the Commonwealth National Collaborative Research Infrastructure Scheme (NCRIS), is a world-leading plant phenomics facility offering state-of-the-art plant growth environments and the latest technology in high throughput plant imaging for the repeated measurements of the physical attributes (phenotype) of plants automatically and non-destructively.

The services enable academic and commercial plant scientists to better understand the factors controlling the performance of particular crops, including: the genetic make-up of the plants, the soil conditions, chemical and nutrient treatments, and environmental stresses. This facilitates an acceleration of crops improvement - generating crops that are more productive, disease tolerant and viable in marginal conditions.

The APPF has two nodes; The Plant Accelerator involving the research institutions at the Waite and The High Resolution Plant Phenomics Centre involving CSIRO Plant Industry and the Australian National University in Canberra.

plant energy biology
ARC CENTRE OF EXCELLENCE

ARC Centre of Excellence in Plant

Energy Biology (Adelaide node)

www.plantenergy.edu.au

LOCATION: Plant Research Centre, 2b Hartley Grove, Waite Campus, Urrbrae

The University of Adelaide established a node of the ARC Centre of Excellence in Plant Energy Biology (PEB) in 2011. The current version of the centre began in 2014 with Professor Steve Tyerman and Associate Professor Matthew Gilliham as Chief Investigators.

The Centre comprises The University of Western Australia, Australian National University, The University of Adelaide and La Trobe University, ten Chief Investigators and over 130 internationally competitive staff and students. It is funded primarily through the Australian Research Council ($26 million) and $14 million from the partner universities to fund the Centre through to 2020.

The research focus of the Centre is to better understand the way in which plants capture, convert and use energy in response to environmental change. The long-term goal is to enhance energy efficiency to improve sustainable productivity of plants.

At the Adelaide node the aim is to improve the efficiency of plant energy use by manipulating the transport properties of gatekeeper cells for water, carboxylates, phosphate and salt.

ARC Industrial Transformation Training Centre in Innovative Wine Production

www.adelaide.edu.au/tc-iwp/

LOCATION: Roseworthy-Hickinbotham Wine Science Laboratories, Hartley Grove, Waite Campus, Urrbrae

Based at The University of Adelaide's Waite Campus, the multi-partner ITTC for Innovative Wine Production provides new knowledge, methods and technologies as well as highly skilled PhD and postdoctoral researchers to tackle the main challenges for the Australian wine industry – climate warming, water restrictions, changing consumer preferences and rising wine alcohol content – leaving the industry better placed to make the wines that the market and consumers want.

Incorporating 12 partners (including all of the WIC members – see below), the Centre represents a unique and exciting training opportunity for PhD and postdoctoral researchers to work closely with leading research centres and Australian and international companies from the wine and food sector.

Wheat Hub
ARC Industrial Transformation Research Hub

ARC Industrial Transformation Research Hub for Wheat in a Hot and Dry Climate

www.wheathub.com.au/

LOCATION: Plant Genomics Centre, Hartley Grove, Waite Campus, Urrbrae

The Australian Research Council Industrial Transformation Research Hub for Wheat in a Hot and Dry Climate marks a new era in wheat breeding and research in Australia. It brings together researchers and Australia's three major wheat breeding companies to exploit global diversity for wheat and advanced genomic technologies for faster development of heat and drought tolerant varieties which make better use of nitrogen fertiliser.

It is funded by the Australian Government through the ARC's Industrial Transformation Research Hubs scheme and the GRDC. Partners include breeding companies AGT LongReach Plant Breeders and Intergrain, the Universities of Adelaide, Sydney, South Australia and the ACPFG.

The Research Hub aims to enhance productivity and secure high grain quality of wheat in the hot and dry Australian climate by:

- Developing wheat with combined heat and drought tolerance by advancing existing knowledge and technologies and transferring wheat material and know-how to breeding programs
- Elucidating mechanisms and molecular markers for combined heat and drought tolerance by exploring wheat genetic diversity
- Identifying mechanisms and genetic diversity for high yielding wheat with efficient nitrogen recycling and high grain protein
- Building human capacity in molecular breeding and providing breeders access to the latest scientific developments and technologies
- Developing and testing high-throughput field phenotyping tools for Australian breeders

wineinnovationcluster.com
Synergy in grape & wine research

The Wine Innovation Cluster

www.thewaite.org/waite-partners/wine-innovation-cluster/

LOCATION: Wine Innovation Central Building, Cnr Hartley Grove and Paratoo Road, Waite Campus, Urrbrae

The WIC is a virtual entity and partnership of four leading Australian grape and wine research agencies. Established in 2008 and

based on the Waite Campus, the WIC strives to build collaboration and create synergies in research and development across the co-located partner organisations for the benefit of Australia's multi-billion dollar wine industry.

The WIC represents critical mass in terms of national wine R&D capability; almost 70 per cent of the total is located at the Waite Campus and incorporated in the WIC. The WIC was established in recognition of the fact that enhanced coordination and integration of R&D is necessary to build the quality outcomes and effective delivery needed by the wine and grape growing industries to meet the challenges of the future.

Collectively, the WIC partners cover the entire grape and wine research, development and extension spectrum and the WIC is continuously exploring opportunities for collaborative research projects.

Non-University partners

Commonwealth Scientific and Industrial Research Organisation (CSIRO)

www.csiro.au

LOCATION: Prescott, Taylor, Cornish and WIC West buildings, Waite Campus, Urrbrae

CSIRO, the national research provider, innovates for tomorrow and offers solutions and technologies today – for its customers, all Australians and the world. CSIRO's research at the Waite Campus seeks to create value for its customers through innovation that delivers economic, environmental and social impact, with particular focus on Australia's agricultural, environment (land and water) and mineral resources sectors.

CSIRO's Waite-based agricultural research is focused on southern farming systems, wine grapes and horticulture, genomic science for crop performance, soil carbon and nutrient cycling and agricultural adaptation to and mitigation of global change.

CSIRO Land and Water's research focuses on environmental resilience, environmental toxicology, managing terrestrial and aquatic ecosystems, water in the resources sector, economics, productivity and sustainability. In the minerals sector, CSIRO's Waite-based research focuses on intelligent mining and resource management.

All of this work is conducted in partnership with a range of research, industry and commercial partners, including the other organisations based at the Waite. Further information is available at: *www.thewaite.org/waite-partners/csiro/*

South Australian Research and Development Institute (SARDI)

pir.sa.gov.au/research

LOCATION: : Plant Research Centre, 2b Hartley Grove, Waite Campus, Urrbrae

SARDI, a Division of the South Australian Department of Primary Industries and Regions (PIRSA), is the SA Government's principal research institute for primary industries creating opportunities to ensure the agriculture, food, aquatic and bioscience industries are internationally competitive and ecologically sustainable. SARDI focuses on value-chain linkages, food security, natural resource and climate adaptation, product integrity requirements, innovation capability and enabling technologies, supplier competitiveness and biosecurity. SARDI science programs are aquatic sciences, livestock and farming systems, and sustainable systems. SARDI has 350 scientific, technical and support staff working at 10 regional research centres in South Australia.

Australian Wine Research Institute (AWRI)

www.awri.com.au

LOCATION: Levels 2 & 3, Wine Innovation Central Building, cnr Paratoo Road & Hartley Grove, Waite Campus, Urrbrae

The AWRI is the Australian grape and wine industry's own research organisation. It supports a sustainable and successful grape and wine industry through world class research, practical solutions and knowledge transfer. Established in 1955, the AWRI is governed by an industry-led, skills-based Board and is a member of the Wine Innovation Cluster. The AWRI's activities are guided by its mission and values, an industry-endorsed research, development and extension plan and an internal business plan. AWRI Commercial Services is the commercial arm of the organisation and provides advanced analytical and consulting services on a fee-paying basis.

The AWRI supports grapegrowers and winemakers by:

- Undertaking strategic and applied research based on the priorities of the Australian grape and wine industry
- Providing a helpdesk service to answer queries from producers and conducting problem-solving investigations
- Presenting roadshow workshops and seminars in Australian wine regions
- Delivering technical information and producing publications
- Conducting events including the triennial Australian Wine Industry Technical Conference, the Advanced Wine Assessment Course and Research to Practice modules
- Providing NATA-accredited analysis and assistance with wine export
- Supervising postgraduate students and providing lectures to undergraduate students.

Australian Grain Technologies Pty Ltd (AGT)

www.agtbreeding.com.au

LOCATION: Level 1, WIC Building, Paratoo Road East, Waite Campus, Urrbrae

AGT was first established in June 2002 by three shareholders: the GRDC, the South Australian Government (PIRSA/SARDI) and the University of Adelaide. AGT now operates the largest wheat breeding program in Australia and, more recently, has expanded into barley and lupin breeding.

Currently, AGT has four major plant breeding stations, Northam (WA), Roseworthy (SA), Wagga Wagga (southern NSW) and Narrabri (northern NSW). The Roseworthy Campus program is the longest continually run wheat breeding program in Australia, running now for more than 130 years.

Breeders and support staff based at each of these centres aim to address the needs of local growers through new and improved varieties. AGT also have a team of highly skilled regionally based marketing and seed production managers who are continuously seeking feedback from growers on how to better meet their needs, while an in-house quality assessment laboratory ensures that growers using AGT varieties can meet the needs of domestic and international markets.

Arris Pty Ltd

www.arris.com.au

LOCATION: Hartley Grove, Waite Campus, Urrbrae

Arris is an innovative Australian-owned consulting and communications company, providing services in two distinct areas: agricultural & environmental services, and marketing/communications. The Arris team has a unique mix of qualifications and experience in science, agriculture, communications, event management, education and training, graphic design, web design and computer technologies and provides services for a diverse range of clients.

Australian Genome Research Facility (AGRF)

www.agrf.org.au

LOCATION: Plant Genomics Centre, Hartley Grove, Waite Campus

AGRF is a not-for-profit company, established in 1997 under the Commonwealth Major National Research Facility (MNRF) Program, and currently supported by NCRIS through BioPlatforms Australia. It is Australia's largest provider of genomics services and solutions. AGRF has laboratories in Adelaide, Brisbane, Melbourne, Perth and Sydney.

The Adelaide node provides a range of services to industry and academia, including illumina and Ion Torrent “Next Generation” sequencing, Sanger DNA sequencing, nucleic acid extraction, controlled environment growth rooms, and varietal identification services. The Adelaide node provides a direct link to the specialist, large scale, and Bioinformatics services provided by AGRF’s national network, and is accredited by NATA to ISO17025:2005.

Appendices

Appendix 1

WRI Members

(Active AFW researchers in 2017)

Able, Amanda
Able, Jason
Andelkovic, Ivan
Arsego, Fabio
Asenstorfer, Robert
Baldock, Jeffrey
Bartowsky, Eveline
Bastian, Susan
Baumann, Ute
Berger, Bettina
Betts, Natalie
Bianco-Miotto, Tina
Bose, Jayakumar
Boutsalis, Peter
Box, Amanda
Breen, Jimmy
Brien, Chris
Buhl, Jerome
Bulone, Vincent
Burton, Rachel
Byrt, Caitlin
Cao, Shifeng
Cargill, Margaret
Cavagnaro, Timothy
Chalmers, Kenneth
Churchman, Gordon
Clarke, Stephen
Coad, Bryan
Collins, Cassandra
Collins, Helen
Collins, Nicholas
Coqui da Silva, Rodrigo
Coventry, David
Coventry, Stewart
Cozzolino, Daniel
Croxford, Adam
Crump, Anna Marie
Cu, Suong
Culbert, Julie
Danner, Lukas
David, Rakesh
Davidson, Jennifer Anne
Davies, Kerrie
De Bei, Roberta
Degryse, Fien
Delaporte, Kate
Denton, Matthew
Dolman, Fleur
Doolette, Ashlea
Dry, Peter
Dundas, Ian
Eales, Kathryn
Eglinton, Jason
Facelli, Evelina
Fincher, Geoffrey
Fleet, Benjamin
Fleury, Delphine
Ford, Christopher
Fox, Rebecca
Franco Garcia, Alex
Garcia, Melissa
Gardner, Jennifer
Garnett, Trevor
Genc, Yusuf
Gibson, Robert
Gill, Gurjeet
Gilliham, Matthew
Glatz, Richard
Gogel, Beverley
Grant, Cameron
Grbin, Paul
Groom, Scott
Habili, Nuredin
Haefele, Stephan
Hanold, Dagmar
Hayes, Julie
Henderson, Sam
Henschke, Paul
Herderich, Markus
Hettiarachchi, Ganga
Heuer, Sigrid
Hogendoorn, Katja
Hrmova, Maria
Hsieh, Yves
Huang, Chunyuan
Islam, A
Ismail, Ismail Ahmed
Jefferies, Stephen
Jeffery, David
Jenner, Colin
Jiranek, Vladimir
Jones, Graham
Kaiser, Brent
Kalenahalli, Yogendra
Kastner, Christine
Keller, Michael
Khoo, Kelvin
Kitonyo, Onesmus
Kleemann, Samuel
Koltunow, Anna
Kookana, Rai
Koopman, Darren
Kovalchuk, Nataliya
Kravchuk, Olena
Krishnan, Mahima
Kuchel, Haydn
Langridge, Peter
Langridge-Reimold, Ursula

Leigh, Roger
Li, Gang
Li, Yongle
Little, Alan
Liu, Haipei
Longbottom, Mardi
Loveys, Beth
Lyons, Graham
Malone, Jenna
March, Timothy
Mares, Daryl
Markovic, Marijana
Marschner, Petra
Mason, Sean
Mather, Diane
Mayo, Gwenda
McBeath, Therese
McDonald, Glenn
McLaren, Tim
McLaughlin, Michael
McNeill, Ann
Melino, Vanessa
Mosley, Luke
Muhlack, Richard
Muhlhausler, Beverly
Navarro, Divina
Niimi, Jun
Nuberg, Ian
Oakey, Helena
Okada, Takashi
Okamoto, Mamoru
Oliver, Stephen
Pagay, Vinay
Paull, Jeffrey
Pearson, Allison
Penfold, Chris
Petrie, Paul
Petrovic, Tijana
Philp, Joshua
Plett, Darren
Potumarthi, Ravichandra
Preston, Christopher
Qiu, Jiaen
Qu, Yue (Julian)
Ramesh, Sunita
Randles, John
Rengasamy, Pichu
Riggs, Karina
Ristic, Renata
Rodriguez Lopez, Carlos
Roy, Stuart
Sadras, Victor
Saucier, Cedric
Schilling, Rhiannon
Schultz, Carolyn
Schwerdt, Julian
Scott, Eileen
Shavrukov, Yuri
Shelden, Megan
Shi, Bu-Jun
Shirley, Neil
Singh, Rohan
Smernik, Ronald
Smith, Andrew
Smith, Sally
Sornaraj, Pradeep
Sosnowski, Mark
Stockley, Creina
Suchecki, Radoslaw
Sumby, Krista
Sundstrom, Joanna
Sutton, Timothy
Sznajder, Beata
Taylor, Dennis
Taylor, Julian
Timmins, Andy
Topping, David
Tricker, Penny
Tucker, Matthew
Tyerman, Stephen
Unkovich, Murray
Vandeleur, Rebecca
Vassos, Elysia
Verbyla, Arunas
Walker, Michelle
Wallwork, Hugh
Watson, Tommaso
Watson-Haigh, Nathan
Watts-Williams, Stephanie
Waugh, Robbie
Wege, Stefanie
Whitford, Ryan
Wilkinson, Kerry
Wirthensohn, Michelle
Wood, Katie
Xu, Bo
Yazdani, Maryam
Zerner, Michael
Zhang, Dabing
Zhou, Jo
Zhou, Yi
Zhu, Ying
Zhu, Yongguan
Zwer, Pamela

Appendix 2

2017 Expenditure

	2017 Actual
WRI Areas of Activity	**$**
Growing the quality of Waite science	489,372
Enhancing the Waite's reputation	30,507
Enhancing Waite collaboration	34,766
Developing Waite people for the future	35,067
Subtotal	**589,712**
Staffing & Administration	202,731
Total Spend in 2017	**$792,443**

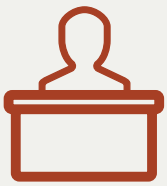
Appendix 3

2017 Publications

To view or download the full list of AFW publications from the 2017 calendar year go to *www.adelaide.edu.au/waite-research-institute/afw-publications-2017*

Books & Book Chapters 14

Journal Articles 416



Conference Proceedings & Reports 19

Patents 1

Appendix 4

List of Relevant Acronyms

ACPFG	Australian Centre for Plant Functional Genomics
AFW	The University of Adelaide's School of Agriculture, Food & Wine
AGRF	Australian Genome Research Facility
AGT	Australian Grain Technologies
AGWA	Australian Grape & Wine Authority
ARC	Australian Research Council
APPF	Australian Plant Phenomics Facility (The Plant Accelerator)
AWRI	Australian Wine Research Institute
CSIRO	Commonwealth Scientific & Industrial Research Organisation
DEWNR	Department of Environment, Water & Natural Resources
GRDC	Grains Research & Development Corporation
HDR	Higher Degree by Research
LIEF	Large Infrastructure & Equipment Funding
NCRIS	National Collaborative Research Infrastructure Strategy
NCSU	North Carolina State University
NRM	Natural Resource Management
NWGIC	National Wine and Grape Industry Centre
PCW	ARC Centre of Excellence in Plant Cell Walls
PEB	ARC Centre of Excellence in Plant Energy Biology
PIRSA	Department of Primary Industries & Regions South Australia
RIRDC	Rural Industries Research and Development Corporation
SAFIC	South Australian Food Innovation Centre
SAHMRI	South Australian Health and Medical Research Institute
SARDI	South Australian Research & Development Institute
SJTU	Shanghai Jiao Tong University
TC-IWP	Training Centre for Innovative Wine Production
UA	The University of Adelaide
WIC	Wine Innovation Cluster
WRI	Waite Research Institute

For further enquiries

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