SOiL CRC

Performance through collaboration

ANNUAL REPORT

2020

CRC FOR HIGH
PERFORMANCE SOILS LIMITED
ABN 63 618 897 224

Contents

MAJOR PARTNERS

The University of Newcastle Australia
Charles Sturt University
NSW Government Department of Primary Industries
Federation University Australia
Griffith University
Manaaki Whenua Landcare Research
Murdoch University
SAGIT
Southern Cross University
University of Southern Queensland
University of Tasmania

PARTNERS

Agriculture Victoria
aora australian organics recycling association
BCG Shared Solutions
Facey Group Shaping the Future
North Central Catchment Management Authority Connecting Rivers, Landscapes, People
NSW EPA
Government of South Australia Primary Industries and Regions SA
SoilsForLife An Outcomes Australia Project
South East Water
wantfa
Wimmera CMA

ASSOCIATES

AIR EP Ag Innovation & Research Eyre Peninsula
Burdekin Productivity Services Sustainability
Corrigin Farm Improvement Group
CWFS Central West Farming Systems
FarmLink
Gillamii Centre Sustainable Agriculture In Practice
HART
HCPSL Herbert Cane Productivity Services Ltd.
Holbrook Landcare Network
LiEBE Group
Mallee Sustainable Farming
MFMG
Nutrien Ag Solutions
Riverine Plains
SPAA Society of Precision Agriculture Australia
SFS Southern Farming Systems
West Midlands Group our knowledge hub
wheatbelt natural resource management

About the Soil CRC

The Cooperative Research Centre for High Performance Soils (the Soil CRC) was established in 2017 to give farmers the knowledge and tools they need to make informed decisions on extremely complex soil management issues.

The Soil CRC bridges the gap between soil science and farm management, bringing together scientists, industry and farmers to find practical solutions for improving the performance and productivity of Australia's soil. This enables farmers to optimise their productivity, yield and profitability, thus ensuring the long-term sustainability of their farming businesses.

Through its soil research and innovation program, the Soil CRC is developing new solutions that are unlocking the potential of Australia's agricultural sector.

The Soil CRC is the largest collaborative soil research effort in Australia's history.

The profitability of Australian farmers can be increased by improving the productivity of their soil.

PARTICIPANTS

- **4** State government agencies
- **8** Universities
- **8** Industry partners
- **20** Farmer groups

Vision

Australian farmers using best practice soil management to underpin a dynamic, sustainable and profitable agricultural sector.

Mission

To contribute new knowledge, tools and practices to help Australia's farmers better manage their soils in order to improve the profitability, sustainability, resilience and well-being of the agriculture sector.

Values

COLLABORATIVE

The Soil CRC is a collaborative and inclusive research and adoption organisation, passionate about soil and bold in its approach to delivering outcomes.

END-USER DRIVEN AND FOCUSSED

The Soil CRC is end-user driven in all things it does. Through farmer and other groups, industry are genuine partners in the CRC, helping to set priorities, develop proposals, undertake research, interpret results and communicate the new knowledge.

MULTIDISCIPLINARY

The Soil CRC employs the necessary disciplines and expertise to deliver change during the life of the CRC, while being aspirational in its long-term goals to ensure a continuing legacy.

RESEARCH EXCELLENCE

The Soil CRC is committed to research excellence – in science practice, capacity building, governance, management, integrity and ethics. The CRC is committed to being a national collaborative leader, recognised as an integral part of Australia's agricultural innovation system.

2020 in Review

- **10** Years' funding
- **$39.5 million** Australian Government investment
- **$127 million** cash and in-kind industry support
- **11 new projects** approved
- **14 PhD students** commenced
- **26** Milestones achieved to date
- **4 programs**
- **$19 million** committed to new projects
- **25 Soil CRC projects in progress**

Chair's Review

Any review of 2019-20 must inevitably start with the impacts of the COVID-19 pandemic.

The Soil CRC first felt the brunt of COVID-19 with the cancellation of the Participants' Conference in Adelaide in mid-March. There were well over 150 registrations from both Soil CRC participants and the wider community – so it was very disappointing to be unable to share our research, knowledge and experience with each other in person. However, as an organisation we were able to adapt, and a very successful series of conference webinars and virtual meetings was held.

As an entity funded by the Australian Government, we have looked at the contribution that we can make to help all Australians in these difficult times and into the future. This has served to emphasise the importance of our role in helping to secure Australia's future food supplies through our research on improving soil management and performance. Through the Soil CRC, all our participants play an important role in contributing to that outcome.

The Soil CRC Strategic Plan 2019-2023 was launched in November 2019, providing a blueprint for the CRC for the next four years. It establishes the priorities and direction for all staff and participants to ensure the Soil CRC is effective in delivering outcomes for agriculture.

The Strategic Plan outlines five strategies to meet our Mission, which is to contribute new knowledge, tools and practices to help Australia's farmers better manage their soils in order to improve the profitability, sustainability, resilience and well-being of the agriculture sector.

These five strategies focus on:

- Research
- Adoption
- Capability and capacity building
- Partnerships and leadership
- Governance and management.

One of the outcomes of the Capability and Capacity Building Strategy is 40 PhD completions by the end of the Soil CRC. The PhD program is a vital part of any CRC, and the Soil CRC is no exception. This year, 14 PhD students commenced in the Soil CRC, bringing the total to 18. The student cohort will gain vital industry contacts and collaboration skills, both from completing their PhD in the Soil CRC, and from working with farmers and farmer groups to get a solid industry perspective on their research.

Collaboration has always been at the heart of our research programs, and with 40 participants including 20 farmer groups involved in the Soil CRC, it is pleasing to see the meaningful, high quality engagement and collaboration that is occurring between participants across all projects.

I implore all participant organisations to continue to maintain this collaboration as a priority in every aspect of their research and adoption activity—despite the challenges of COVID.

I was saddened to hear of the ongoing health issues that have caused Major General Michael Jeffery to step down as the Patron of the Soil CRC. I want to thank General Jeffery for his passion and commitment to the issue of soil health, and for his unceasing advocacy of the importance of soils in Australia. He has been a valued and important part of the Soil CRC from its inception.

As we face the coming year, with all the unknowns that COVID may bring, rest assured that the priorities of the Soil CRC remain steadfast. We are committed to our Vision: Australian farmers using best practice soil management to underpin a dynamic, sustainable and profitable agricultural sector.

In conclusion, I would like to extend my gratitude and thanks to the members of the Board and management for their valuable contributions again this year.

On behalf of the Board, I would also like to thank all the participants and staff of the Soil CRC for their efforts and work to make the CRC an effective and relevant centre for soil research.

Dr Paul Greenfield AO FTSE
Chair, Soil CRC

Chief Executive Officer's Report

The third year of the Soil CRC, 2019-20, began with the Prime Minister, the Hon Scott Morrison, speaking of the importance of the Soil CRC at the Bush Summit in Dubbo on July 18.

He spoke of the challenges of soil management, and farmers being at the forefront of managing this vital asset on behalf of the largely urban Australian population. He specifically highlighted the Soil CRC as the largest collaborative soil research effort in Australia's history and said that "its work is essential to the health of the bush".

As the year unfolded, various parts of the country faced the challenges of drought, bush fires and floods, each of which tested the resilience of our soils and the "health of the bush". In turn, it was through the life-giving resource of our soils that those who make a living from agriculture were able to recover, thus serving to emphasise the truth of the Prime Minister's words in Dubbo.

As if those challenges were not enough, we were then confronted with the COVID-19 pandemic. The Soil CRC head office team and the wider Soil CRC team of researchers and participants adjusted quickly to the restrictions and adapted their operations in response to the challenges of COVID-19. While it is still not quite business as usual, we are getting on with the job, research is continuing, and we are focussed strongly on how to improve the productivity of Australia's soil—and in turn increase the profitability of Australian agriculture.

Unfortunately, the imposition of COVID-19 related restrictions led to the cancellation of our 2020 Soil CRC Participants Conference, which was to have been held in Adelaide in March. Following the success of the inaugural conference in Newcastle in 2019, this was a much-anticipated event, and was to be the major opportunity in the year for Soil CRC participants to come together and exchange ideas and learnings. Alas, it was not to be, but we look forward with eagerness to March 2021 when we can hopefully hold the 2021 Conference in Adelaide without disruption.

The development and release of the Soil CRC Strategic Plan 2019-2023 helped us to identify and focus on what is really important to the achievements of the CRC, and gives us the confidence to move forward with our participants and other partners. In turn, with input from our participants, we commenced a review and revision of the CRC's outputs and milestones, recognising that many factors have changed since they were first drafted in 2016.

Through the first half of the year, until COVID-19 led to travel restrictions, I really enjoyed the opportunities to travel the country to meet with our various participants, from farmer groups through to universities. I met with farmers and deputy vice chancellors, and with scientists and students, adding to my understanding of their motivations and aspirations for the CRC, and learning more about the contributions they can each make to its success. I look forward to being able to resume these visits in the second half of 2020-21 and beyond.

I would like to thank the Board, led by Dr Paul Greenfield, and the various supporting committees for their support and guidance throughout the year.
The four Program Leaders – Catherine, Richard, Nanthi and Lukas – provided excellent science leadership to their respective programs. Importantly, the staff – Jodi, Mark, Katherine, Julie, Millicent, Cassandra, Jessie and Kathy – all made significant contributions to their respective areas and helped to ensure the smooth and successful operation of the Soil CRC, especially in the face of the pandemic and its impacts.

Finally, I would like to acknowledge the support of Major General Michael Jeffery in his capacity as National Soils Advocate and as the inaugural Patron of the Soil CRC – a role he has now relinquished due to ill health. We wish him well.

I commend this annual report to you as formal record of our third year.

Dr Michael Crawford
Chief Executive Officer, Soil CRC

Achievements

The Soil CRC Strategic Plan 2019-2023 was launched at the Soil CRC Annual General Meeting in November 2019. The plan outlines the strategic objectives and priorities for the Soil CRC over the next four years of our ten-year CRC. There are five high level strategies, under which are listed a number of objectives, expected outcomes and actions:

- Research
- Adoption
- Capability and capacity building
- Partnerships and leadership
- Governance and management.

The plan was developed by the Board with input from Program Leaders and staff – and will guide the Soil CRC's investment and activity over the next four years, enabling it to deliver on its objectives.

The Annual Soil CRC Participants Conference was to be held in March in Adelaide, but unfortunately had to be cancelled due to the COVID-19 pandemic. With well over 150 delegates registered and a three-day program including one day open to the wider general public, we were very disappointed to be unable to hold this conference as planned.

However, we quickly reorganised ourselves to host four separate webinars, each showcasing a Soil CRC Program and two projects. These were well attended and generated engaging Q&A sessions. We also held our Program meetings online where we workshopped variations to our milestones, and a PhD student workshop. Other planned project workshops all went ahead, albeit virtually.

11 new projects were approved by the Soil CRC Board at its April meeting, with a total lifetime investment of $4.1 million. This brings the total number of approved Soil CRC projects to 47. The CRC has now allocated $19 million of its cash resources to projects.

Project delivery commenced in earnest across all Programs and all states of Australia. Staff were appointed, laboratory, glasshouse and field experiments commenced, and project teams started collaborating on undertaking the exciting research work of the Soil CRC.

The Soil CRC welcomed 14 additional PhD students in 2019-20. With a total of 18 students and 15 open PhD positions, the Soil CRC is well on the way to meeting its target of 46 PhD commencements by 2023.

Dr Cassandra Wardle was appointed as the Soil CRC Student Coordinator in February. Cassandra's role is to work with the cohort of Soil CRC PhD students across the country and assist in providing them with the industry training and exposure that will ultimately distinguish our graduates as PhD graduates of the CRC.

The Soil CRC announced a $6.75 million project with co-investment from the Grains Research and Development Corporation (GRDC) to investigate innovative solutions for low crop performance on highly calcareous soils.

The three-year project is led by Soil CRC participant, the South Australian Department of Primary Industries and Regions (PIRSA) with collaboration from farmer groups and other CRC participants.

The Soil CRC newsletter established itself as a premium and valued communication product of the CRC. Produced every two months, it is now sent to over 1000 recipients, both inside and outside the Soil CRC, and provides an opportunity to highlight our people and our research.

The Commercialisation and Intellectual Property Advisory Committee (CIPAC) was established. The primary role of the CIPAC is to oversee the intellectual property and commercialisation activities of the Soil CRC. The CIPAC is chaired by Board member, Dr Anna Lavelle.

The Soil CRC Annual General Meeting (AGM) was held in Sydney on 27 November, 2019, and was attended by participants both in person and online. In accordance with the Constitution of the CRC for High Performance Soils Limited, the first three appointed Directors 'retired' at the second AGM, along with Di Parsons who stepped down earlier in 2019. Steve Carr (Facey Group) was elected as the representative of the Partners and Associates Collectives. Ralph Hardy re-nominated and was approved as an independent director. There were four nominations for the two non-independent director vacancies representing the Major Partners.

Malcolm Buckby (SAGIT) was reappointed to the Board and a new Director, Andrea Bishop (Griffith University) was elected. We thank outgoing Director, Kevin Hall (University of Newcastle) for his significant contribution, both to the Board, and importantly, for his contribution to the development and successful funding of the Soil CRC.

Research

The Soil CRC recognises that sustainable, productive, high performance soils are integral to the future success and prosperity of the Australian agricultural sector.

Soil CRC research is focussed on providing Australian farmers with knowledge and tools to improve their soil performance and their farm's productivity and profitability.

In our third year, we made further progress towards reaching this goal. The release of the Soil CRC Strategic Plan 2019-2023, with its clear vision and mission statements, reinforced the CRC's objectives.

Research activity progressed significantly with 25 projects underway and the completion of three projects taking the total completed projects to 15.

The Board approved 11 new projects for funding with four commencing during the reporting period.

The third major investment call for projects was released during the reporting period. All proposals were assessed by the Research and Adoption Committee (RAC) and submitted to the Board, which approved nine projects.

Two other projects were approved in the special project category. Identifying drought as a key issue facing the agricultural sector, the Board released a special call for research into managing soil for high performance after a drought, and a project was approved and commenced.

This project was a collaborative effort between PIRSA and Agriculture Victoria, with specific skill sets focussed on collecting information and then effectively disseminating this to participants and the wider agricultural community.

Soil CRC participants also drove the establishment of a special project on addressing low crop performance on highly calcareous soils with the Grains Research and Development Board (GRDC).

The Soil CRC is currently on track to meet its research output targets, with all six milestones due for completion during 2019-20 being achieved on time. The Soil CRC has now successfully completed 26 milestones, and has commenced activities in a further 39 milestones.

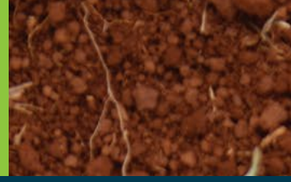
During the year, in collaboration with all participants, the Soil CRC commenced a formal review of the Commonwealth outputs and milestones that were developed and agreed to in 2016-17.

These outputs and milestones were reviewed for their ongoing relevance and currency. Input was sought from participants, and findings delivered from previous research activities undertaken by the Soil CRC were reviewed. At the end of the year, the Soil CRC had identified numerous proposed changes that would be reviewed by the Board and submitted to the CRC Program Office for consideration early in the next year.

The high levels of industry and participant involvement in the Soil CRC research continued. The ratio of participant in-kind contributions to Soil CRC cash committed to all projects (including those approved this year) averaged at 2.3. The Research and Adoption Committee applies a weighted assessment that prioritises the level of in-kind contribution committed by participants when recommending proposals to the Board for funding.

The Soil CRC has continued to effectively monitor and manage all research projects during the year for delivery of outputs and research quality via the following mechanisms:

- Continued use and improvement of the Online Project Management System, SoilCentral
- Submission and assessment of quarterly project reports from project leaders
- Monthly meetings between the CEO, four Program Leaders and the Operations Manager
- Initiation of targeted reviews with a specific focus, such as intellectual property and commercialisation
- Annual review of Commonwealth milestone progress by the CEO, four Program Leaders and the Operations Manager
- Regular reporting of research investments to the Soil CRC Board, including project agreement execution status, project commencement and completion dates, PhD student progress, project quarterly report summaries and Commonwealth Milestone Reports
- Oversight of project investments and progress by the Research and Adoption Committee.



PERFORMANCE AGAINST ACTIVITIES

A significant highlight for the year was the completion of a gate review of a project. As part of the project approval process, the Soil CRC formally identifies projects that are higher risk, meaning there is a higher likelihood that the project may not achieve the desired outcome.

For all high-risk projects, a gate review is a mandatory requirement to be conducted at the half-way point of project duration, to determine if the risk is manageable and if the project should continue. The Soil CRC successfully applied the gate review process and assessed a project.

The project was endorsed to continue but with modifications to the objectives and outputs, as recommended by the gate review panel that included an external expert in the research area. This demonstrates that the Soil CRC is committed to ensuring delivery from research activities to our participants.

Furthermore, as the Soil CRC has now made investment commitments in excess of $19 million towards research projects, we commenced planning for an internal investment portfolio review of all projects to be completed early in the next year.

The Soil CRC continued to utilise the established Investment Framework that contains the following categories:

1. MAJOR INVESTMENT ROUNDS

Proposals in these rounds become the core projects of the Soil CRC and may include research, education and/or training (including PhD students). The types of projects called for (referred to as priorities) in each round are at the discretion of the Management Team and RAC, and are in alignment with the Commonwealth milestones.

2. MAJOR INVESTMENT ROUNDS: STUDENTS

Proposals in these rounds are only for education and or training (including PhD students). As per the Commonwealth Agreement, the Soil CRC must commence 46 PhD students and complete 40 to 46. Depending on student numbers within projects funded through the Major Investments Rounds, the Soil CRC may raise a separate call for students.

The major rounds are supplemented by two further investment categories:

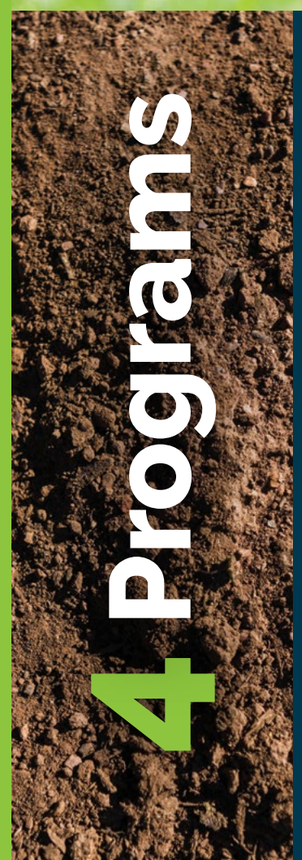
3. ONGOING EXPRESSION OF INTEREST (EOI)

This will be an open ongoing call for any research that is found to match Soil CRC objectives and milestones, but that is discovered outside the normal funding cycle(s). Projects funded under this call must justify why they need to be considered immediately, rather than within the normal investment round cycles.

4. SPECIAL PROJECTS (SP)

These projects will be attributed to a particular requirement (such as external investment), or strategy (e.g. commercialisation). Depending on each circumstance surrounding the need for a project or external funding support conditions, these projects may not be called for publicly.

Categories 3 and 4 enable the Soil CRC to remain agile, rapidly responding to issues and opportunities as they arise. Both of these categories were used during the year.



The research activities of the Soil CRC are being delivered through four research programs:

1. INVESTING IN HIGH PERFORMANCE SOILS

Supporting farmers to maintain the long-term integrity and fertility of soils for future generations.

2. SOIL PERFORMANCE METRICS

Developing tools that allow farmers to monitor and assess the performance of their soils, and take corrective action where needed.

3. NEW PRODUCTS TO INCREASE FERTILITY AND FUNCTION

Developing a range of new products to better address challenges in soil management.

4. INTEGRATED AND PRECISION SOIL MANAGEMENT SOLUTIONS

Synthesising our current understanding of soil science and how it should be applied to the key soil types across Australia under irrigation and dryland agriculture.

Program 1

Investing in high performance soils

Associate Professor Catherine Allan,
Charles Sturt University

Program 1 aims to assist farmers achieve their soil stewardship and profitability goals through research in the disciplines of economics and social science.

The inclusion of Program 1 in the Soil CRC is an acknowledgement that the influence of markets, policies and societal norms can lead Australian farmers to make management decisions that can be detrimental, or supportive, to soil performance and farm profitability in the medium to long term.

The tools and approaches for addressing soil constraints that are being developed within the Soil CRC have great technical value, but their uptake and use will be influenced by the social and economic settings of the potential users. While the ultimate end user of Soil CRC research is the farmer or land manager, much of the research effort in Program 1 is directed at, or undertaken in partnership with, next users – other researchers, advisors and grower groups – who support farmers.

Program 1 researchers are broadening the options for farmers to manage soils productively in the medium to long term by:

- seeking ways to activate markets to reward good soil stewardship,
- informing and guiding soil experts to ensure their technical innovations are useful and needed by farmers,
- developing partnership models for enhanced innovation capacity within the agri-ecosystem, and
- providing evidence of financial and other risks and benefits related to specific innovations.

RESEARCH

Program 1 has six active projects and three PhD students.

Program 1 researchers aim to ensure that innovative soil management practices are implemented by creating optimal situations or environments that enable this. For example, in 2019-20, two related projects were assessing ways to use economic rewards to encourage land managers to make decisions that improve soil health, fertility and function.

One focal area of inquiry is consumer markets. Through in-depth interviews, Soil CRC researchers examined whether domestic purchasers of food and fibre, and their retail and wholesale providers, are able to understand and reward soil stewardship.

Early indications are promising, and research in this area is ongoing. In related work, systemic co-inquiry among those in the finance and farming industries sought to determine how the two can work in a mutually beneficial way.

By bringing together groups in the agri-ecosystem who rarely interact, a shared interest in potential new financial instruments and guides was discovered. This interest, and commitment to continue the inquiry, led to development and funding of a major new project to co-develop instruments that mutually reward farmers and their finance providers for rationally considering soil stewardship.

Program 1 researchers are also seeking to better understand the complex situations in which soil management decisions are made. The aim is to provide guidance on where technical research efforts may have the greatest positive impacts.

Six social benchmarking surveys are being conducted to better understand the influences on farmer decision making. The results for Victoria's North Central Catchment Management Authority region were published, the survey for South Australia's Eyre Peninsula was administered, and a survey for the Western Australia wheatbelt developed.

Related research is focusing on farmer uptake of innovations. During 2019-20, workshops and interviews with members of seven farming systems groups were completed, and analysis commenced.

The potential for applying a systemic, participatory approach to district or group-scale soil-related risk assessment and management was explored with three participant organisations. Although some potential for ongoing activity was identified, we will not continue with this approach as a stand-alone endeavour. Instead, consideration of risk will be embedded in projects that are directly linked with innovations.

Five participatory action research partnerships involving Program 1 researchers and farming systems groups have been created and supported. These tested the applicability of a Systems Innovation Intervention Framework to enhance the capacities of farmer groups to lead research and innovation.

PhD research is providing additional insights, with three students investigating social norms of soil management, the influences on decision making in the 21st Century, and aspects of transitioning to alternative practices.

Program 1 Projects

UNDERSTANDING AND PROMOTING GOOD SOIL STEWARDSHIP

1.1.003, Mark Morrison, CSU, 2018-2021

Partner: UTas

This project is assessing consumer demand for good soil stewardship and developing communication strategies for promoting it. Five focus groups of consumers in urban and regional Australia concluded that unless you have a connection to the land, your knowledge of soil stewardship is generally limited. Consumers have been allocated into four segments and the different factors that influence their food purchases have been identified. Some segments may be willing to pay for improved soil health – for different reasons such as health, environment and supporting farmers. It's also possible that where consumers would not pay more for good soil stewardship, they may be more likely to choose products with this feature if they are considered to be better for their health, the environment and for farmers.

WHY SOIL MANAGEMENT PRACTICES ARE ADOPTED

1.2.002, Vaughan Higgins, UTas, 2019-2021

Partners: CSU, USQ, WANTFA, MFMG, BCG, RPI, CWFS, EPARF

This project is examining the effectiveness of current strategies for the promotion and adoption of improved soil management practices used by farming groups. It involves working with farmer groups to develop a framework and criteria for adoptability across different areas and farming systems. Findings show that relying on diffusion to drive adoption is risky and likely to be slow; farmers care for their land, but they have financial constraints; and diversity of regional soil improvement needs to be understood by soil scientists. There is a need to provide more support in interpreting soil data. The next step is to research the broader political and institutional drivers for adoption of improved soil management to enable policy and commercial settings to better support adoption.

COLLABORATIVE APPROACHES TO INNOVATION

1.2.003, Nick Pawsey, CSU, 2019-2020

Partners: FedUni, Murdoch, USQ

This project was completed in April 2020.

It investigated how farmers can be financially rewarded when they manage their soil well. It took a multi-disciplinary approach, involving soil researchers, farmer groups and the finance industry. Working together, they established a shared understanding of the soil-farmer-finance 'system'. The longer-term objective was to ensure that agricultural financial decision processes, together with land valuation practices, recognise farmers who enhance soil condition and also recognise the costs of soil degradation. This is to enable increased access to lower cost finance for farmers who engage in practices recognised as improving soil security, condition and productivity.

SURVEYING ON FARM PRACTICES

1.2.004, Hanabeth Luke, SCU, 2019-2021

Partners: CSU, NC CMA, NSW DPI, WANTFA, PIRSA, EPARF, WMG, Eyre Peninsula NRM

This project is providing an understanding of what factors influence farmers when making decisions on soil management practices. Six regions are being surveyed. Three of the six surveys have been initiated – in North Central Victoria, Eyre Peninsula, SA and the Wheatbelt of WA. Findings show that the age of farmers is an important factor in how they receive information on soil management. Also, soil productivity is not only an issue for full-time farmers but also for part-time farmers in areas where the soil conditions are difficult.

COLLABORATIVE DEVELOPMENT OF AN INTEGRATED RISK-ASSESSMENT PROJECT

1.3.001, Kala Saravanamuthu, UON, 2019-2020

Partners: BCG, CSU, CWFS

This project was completed in May 2020.

Decisions about sustainably increasing soil productivity are often influenced by financial profitability rather than considerations of ecosystem resilience. This project used integrated risk management software to facilitate collaborative resilience thinking. It integrated field data about on-farm productivity with farmers' and experts' real-world experiences of how farm productivity is affected by the consequences of unsustainable practices. The project used a web-based, integrated risk platform to socially integrate the multi-dimensional attributes of soil re-engineering interventions, enabling the transfer of knowledge between scientists and farmers as they examine the consequences of re-engineering.

BUILDING FARMER INNOVATION CAPABILITY

1.4.002, David Falepau, CSU, 2019-2020

Partners: BCG, CWFS, EPARF, HCPSL, RPI

This project was completed in June 2020.

It began the refinement of a partnership approach that builds the long-term capability of farmers, through farmer groups, to lead the innovation process. This begins with ideation through to commercialisation and finally adoption. Farmers are most likely to adopt the technologies and practices that they initiate or develop. The project trained an innovation manager within each participating farmer group, on how to design and implement an innovation system. They were also trained on how to support farmer members to build their capability to develop innovative soil management technologies and practices specific to their farms and management systems. The longer-term vision for this project is to roll out this innovation capability partnership model to other Soil CRC farmer groups and agribusinesses and beyond.

Program 2

Soil performance metrics

Associate Professor Richard Doyle, University of Tasmania

Program 2 is developing tools that allow farmers to monitor and assess the performance of their soils and take corrective action where needed.

This includes delivering data quickly and cost effectively to farmers and agronomists. It also involves challenging existing chemical and physical assessments as well as looking to novel techniques that might help land managers determine soil biological health and function more easily.

Program 2 will invest greater research and development efforts in spatial sensing of soil properties, key indicators of soil biological functionality and the development of useful sensors. It will do this by linking traditional approaches with new and enhanced geophysical and sensor methods for mapping both soil water and nutrient availability.

RESEARCH

Program 2 has five research projects and six PhD students.

Program 2 researchers are working on relating soil moisture content to the energy status of water in soil, which is what a growing crop 'sees'. This work involves a PhD project that has scoped the problem and set a pathway for more focused research on this challenge.

Other researchers in Program 2 are examining subsurface communication systems that allow easier use of in-ground soil sensors. This is conducted alongside work on a device that simultaneously assesses soil strength, moisture and location in an easy to use farmer-friendly probe (called a smart shovel).

Researchers are investigating devices for in-field extraction of the soil solution (water) for rapid in-field chemical testing.

This includes technologies such as lab-on-a-chip and nano-carbon based ion selective electrodes (similar to a pH meter).

Various teams across Australia and New Zealand are working at two ends of the soil solution chemistry question. The aim is to provide end-users with a cost and time effective, in-field test. Project teams are developing prototype soil nutrient testing capacity via both ion selective electrodes and lab-on-a-chip devices (micro-fluidics) to assess soil chemical health more easily. These will link to smart phone camera-based scanning, GPS-locating and analytical capability.

Another approach that researchers are taking towards better in-field soil health monitoring, is using a prototype electronic nose to analyse soil gas. The device, now in its fifth prototype, is ready for field testing in current Soil CRC field trials and research projects.

Researchers are linking these analytical technologies to smart phone capabilities and data analytical tools to interpret and provide recommendations to farmers and agronomists on their soil management. These include techniques such as cluster analysis, neural network analysis, machine learning and geo-statistical analysis.

Other projects are addressing soil data management and visualisation issues. This is enhancing how end-users store, access, view and receive both point and spatial soil data, including paddock trends and data interpretations. The Visualising Australasia's Soils project team has worked with farmer groups across the country to better understand their data storage, use and visualisation needs. A data portal was launched in December 2019 – which will expand as data is combined and added to both climate and crop models to assess soil management interventions such as when, with what, and at what rate?

Several new PhD projects were funded and students are working in spatial analysis of various drone and satellite based hyper-spectral imagery to determine how these can be used for making better soil management decisions.

Program 2 Projects

SMELLING SOIL

2.1.004, Shane Powell, UTas, 2019-2020

Partners: BCG, FarmLink, SFL, SFS

Farmers often intuitively assess soil by smell. The fingerprint of gases emitted from soil may be able to reveal the composition and activity of the microbial community that relates to soil health. Currently, there are no field-based sensors to diagnose soil health using aromas. An 'electronic nose' offers a solution to this problem. The prototype eNose is being co-developed with farmers to ensure that the technology is useful, usable and provides relevant information that is easily interpreted and understood by farmers themselves. Being able to do this will mean that farmers can make the right management decisions to improve crop performance and yield, especially in poor soils. The eNose prototype has been developed and is currently being tested with farmers, with more testing to come.

'SMART' SOIL SENSORS

2.2.002, Marcus Hardie, UTas, 2019-2022

Partners: FedUni, USQ

This project is developing the next generation of 'smart' sensors that will overcome the problems associated with above ground sensors transmitting data over large areas, while automatically interpreting sensed data in order to provide farmers with actionable information rather than just data. Following consultations with farmer groups, progress is being made on the development of two 'smart' shovels. Development of a self-learning moisture sensor continues, with experiments conducted to determine the best approach. A below-ground sensor for data transmission is also in experiment phase. These products will help farmers make sustainable and precise management decisions and improve soil function.

NEW SENSORS FOR MEASURING SOIL NUTRIENTS

2.2.003, Craig Lobsey, USQ, 2019-2022

Partners: Landcare NZ, HCPSL, Burdekin

This project will provide farmers and their advisers with tools to help them make the best possible decisions in nutrient and water management. It is developing sensor technology that enables a detailed measurement of soil nutrient status and supply, through the soil profile and across the field. This will provide unprecedented insights into the nutrient status of the soil and the mobility of these nutrients under irrigation and rainfall scenarios. With this technology, the distribution of nutrients through the soil profile can be better controlled to maximise both farm profitability and environmental sustainability. The sensor technology and algorithms being developed in this project will be the mechanism by which information on nutrient status and dynamics can finally be provided to farmers and their advisers—enabling a step-change in soil management practices for both profitability and environmental sustainability.

AFFORDABLE RAPID FIELD-BASED SOIL TESTS

2.2.004, Liang Wang, UON, 2019-2022

Partners: UTas, HCPSL, Burdekin

This project is developing an affordable field-based tool kit for farmers to quickly determine soil chemical properties on their farms. Using a mobile and desktop interface, it will access measurement data and provide crucial soil nutrient information for the users. The project is working on ensuring accuracy using colorimetric reagents, which are simple and affordable. It is developing a disposable and affordable device that can simultaneously determine multiple soil key chemical indicators in the field. It is investigating an application of colorimetric methods in a 3D printed microfluidic device. By using this device, soil solutions can be measured directly in the field with a mobile phone, without the sample preparations required of other on-site analysis methods.

VISUALISING AUSTRALASIA'S SOILS

2.3.001, Peter Dahlhaus, FedUni, 2018-2021

Partners: Landcare NZ, UTas, USQ, BCG, BPS, CWFS, Gillamii, HCPLS, Nutrien, Liebe, MFMG, MSF, NC CMA, RPI, SFS, WANTFA, Wimmera CMA

This project aims to establish a soil research data federation, based on agreed data stewardship and governance frameworks, that allows Australasian soils data from all sources (private and public), to be discoverable to all Soil CRC participants, and publicly, through an intuitive-to-use internet portal. An extensive consultation involving 16 participant organisations revealed that free access to a trusted, supported, web based spatial soil data management system that they could use to support their organisation's goals and membership is important. To ensure longevity and success of this project, data ownership, security and reuse will be addressed. A pilot data portal was launched in December 2019, which enables farmers across Australia and New Zealand to see soil data from both public and private sources. It will host a data federation that operates under agreed data stewardship and governance frameworks. The data portal demonstrates the complexity of visualising some of the 23,000 publicly available soil data sets from around Australia.

Program 3

New products to increase fertility and function

Professor Nanthi Bolan,
The University of Newcastle

Program 3 aims to develop a range of new fertilisers, soil amendments and delivery mechanisms to help farmers enhance the performance of their soils.

The appropriate use of nutrients, water, pesticides and soil amendments is critical for improving soil health and function. These inputs contribute to the economic outcomes of farm production and profitability and their efficient use is fundamental to achieving the yield potential of agricultural crops. However, there is only a limited range of products currently available for farmers to manage complex soil constraints.

RESEARCH

Program 3 has six research projects and five PhD students.

Program 3 researchers are utilising products from natural resources by using emerging technologies such as polymers, nanotechnology and biotechnology. They are working on the recovery of high-grade fertilisers from organic waste streams; the development of a controlled release pesticide delivery system; alternative microbial and moisture carriers; novel amendment formulations to ameliorate subsoil sodicity, acidity and salinity; and organic and clay amendments to improve the productivity of sandy soils.

Major research progress has been achieved in recovering phosphorus from wastewater streams (recycled water and farm effluents), encapsulating pesticides using nanoporous clay matrix, synthesising microlime and microgypsum soil amendments, and evaluating alternative rhizobium carriers. Addressing regulatory requirements is an important part of this process.

The low concentration of nutrients in wastewater streams is a major challenge in recovering nutrients. The research team has developed nanoseeding techniques to recover phosphorous from recycled water and farm effluents using zirconium and apatite. These products can be directly or indirectly used as a nutrient source.

Researchers have created nutrient-enriched biochar fertiliser samples that have been synthesised using chicken manure and cow manure to produce biochar. The biochars have been subsequently 'hydro-reacted' with nitrogen, phosphorus and potassium solutions. These are then being tested for nutrient release characteristics and bioavailability.

Progress has been made in the challenging area of managing subsoil constraints such as sodicity and acidity. Researchers have synthesised micro-gypsum and micro-lime, which have been found to be effective in the amelioration of subsoil sodicity and subsoil acidity in glasshouse trials.

There are potential opportunities for the utilisation of products and technologies that have been developed in Program 3. Compost industries are keen to promote the use of compost products in mainstream broadacre agriculture. Hence, the focus could shift to developing high-value compost formulations and examining their values as a nutrient and carbon input to soil—instead of aiming for the synthesis of new fertiliser products. Similarly, soil amendments that are developed – such as micro-lime and functionalised clay – will have a direct impact on mitigating site-specific soil constraints.

The utilisation of moisture retention products will help improve water retention, building drought resilience and improved soil health.

A major challenge is the limited range of substrate (clay-based materials) used for encapsulation of pesticides as part of a current project. Future projects should focus on a range of substrates for the encapsulation of herbicides to achieve their targeted delivery and reduced residual effect on main crop and soil microorganisms.

Program 3 had five PhD students, with projects ranging from the synthesis of nutrient-enriched biochar-based fertiliser products, through to the identification and characterisation of novel carriers for rhizobium inoculation.

Program 3 Projects

RECOVERING NUTRIENTS FROM ORGANIC WASTE STREAMS

3.1.003, Dane Lamb, UON, 2018-2021

Partners: Griffith, SCU, CWFS, PIRSA, AORA, SEW, HCPSL, Landcare NZ

This project aims to develop innovative fertiliser products derived from wastewater from various sources such as poultry and pig manure, dairy farm wastes, sewage and industrial effluents. This has the dual benefit of developing cost-effective new products, while also limiting the potential environmental impacts associated with excess nutrients in wastewater. The project is currently using three different approaches for the development of fertiliser products, which are being trialled for effectiveness.

APPLICATION OF LIQUID BIOSOLIDS

3.1.004, Aravind Surapaneni, SEW, 2019-2022

Partner: UON

Finding innovative uses for biosolids in agriculture is challenging. Using nutrient rich organic waste materials including biosolids (sewage sludge) could be an economically viable alternative to fertilisers, given their rising costs. The project is conducting trials at Longwarry Water Recycling Plant in Victoria with the aim of improving soil structure, fertility and function. The results from pre- and post-injection groundwater and soil monitoring indicate minimal accumulation of nutrients and contaminants in the vicinity of the trial site. However, a localised area near the trial site and other treatment infrastructure, exhibited increases in nutrient levels and other parameters, requiring further investigation. The project will continue monitoring soil, groundwater and herbage samples through different seasons and cropping until January 2021.

IMPROVING PESTICIDE DELIVERY EFFICIENCY

3.2.001, Yanju Liu, UON, 2019-2022

Partners: Burdekin, Griffith, HCPSL

Pests and insects are causing damage in agriculture, requiring significant application of pesticides and insecticides. This project is focusing trials on sugarcane and the cane beetle, which damages the productivity of sugarcane by feeding on roots and stems, causing losses in hundreds of millions of dollars annually. The traditional application of insecticides has resulted in a large residue in soils and surrounding environments, damaging soil enzyme activity and impacting nutrient availability. This project is examining nano-porous materials (either natural or carbon-based materials) as potential carriers to improve pesticide delivery. Encapsulation of imidacloprid insecticide using nanoporous clays and the controlled release of the insecticide are being investigated.

NEW PRODUCTS FOR SUBSOIL CONSTRAINTS

3.3.002, Ehsan Tavakkoli, NSW DPI 2019-2022

Partners: UON, USQ

This project is using recent advances in chemical engineering techniques and innovative organic based amendments to more effectively address subsoil constraints. It is developing a new generation of submicron organic-based amendments with the aim of correcting subsoil constraints and thereby increasing crop production. The project team has made significant progress in developing new organic-based gypsum and lime products. They have developed a specific type of micronized biochar and silicon polymer, which carries lime and gypsum minerals. The characterisation of these products is well underway. This will be followed by soil-based studies.

NEW AMENDMENTS FOR SANDY SOILS

3.3.003, Richard Bell, Murdoch, 2019-2021

Partners: PIRSA, FedUni, WMG, AORA

Sandy soils cover 11 million hectares of agricultural land in South Australia alone. Crop productivity is generally lower on sandy soils. This project proposes that step changes towards high performance sandy soils will come from permanently raising their reactive surface area, with added clay or recalcitrant organic matter or both. The project is designing a long-term, multi-site field program for improvement of sandy soils with clay and organic amendments. The results should help farmers to manage their sandy soils more productively.

EVALUATING ALTERNATIVE RHIZOBIAL CARRIERS

3.4.001, Chengrong Chen, Griffith, 2018-2022

Partners: UON, WANTFA, Murdoch, CWFS, HCPSL, Burdekin, AORA

Rhizobium inoculation of seeds helps increase the supply of nitrogen in most farming systems, but peat, the most widely used rhizobial carrier, is a non-renewable resource that is fast becoming scarce. The existing inoculation techniques often result in low survival rates of rhizobia on the seed due to desiccation and heat, which limits the nitrogen-fixing efficacy of the inoculants. This project is using a suite of advanced analytical approaches to evaluate locally available, low cost organic and inorganic materials, biochars produced from different feed stocks and pyrolysis conditions, and emerging biopolymers, as alternative carriers for effectively delivering rhizobia. The project is addressing the issue of capturing and retaining moisture to improve prolonged survival of rhizobial inoculants.

Program 4

Integrated & precision soil management solutions

Dr Lukas Van Zwieten,
Department of Primary Industries NSW

Program 4 aims to achieve cost effective and sustainable solutions to address complex soil problems.

Program 4 was established to deliver new knowledge, and innovative integrated solutions to develop high performance soils – thus underpinning a dynamic, sustainable and profitable Australian agricultural sector. Projects within Program 4 have now engaged with 13 grower groups, eight Universities, three Government research partners and one international research provider.

RESEARCH

Program 4 has eight research projects and four PhD students.

Program 4 researchers are assessing potential improvements to soils through the adoption of regenerative farming practices, and seven farms (paired site comparison) have been identified for more extensive testing. Some initial results from field trials have shown that cover cropping in a sugarcane farming system (from Herbert Cane Productivity Services Limited) can make soil more biologically resilient to stress.

Projects are identifying plant based and biological solutions to develop high performing, more resilient soils. Researchers have been investigating agronomic practices such as cover cropping and biological approaches to manipulating the rhizosphere environment, as well as regenerative farming systems that may increase soil carbon, soil resistance and resilience to stress, and stimulate soil biological processes. Five field trials across the key regions, two small plot mechanistic studies and seven paired regenerative farming systems are being studied.

Researchers are applying new ways to evaluate changes to 'soil performance'. Specifically, responding to the questions: 'Is my soil resistant to a stress?' (the amount of change caused by a disturbance) and 'Is my soil resilient?' (the speed with which a system returns to its pre-disturbance level). Field trials have been established with farmer groups to test cover cropping. These are being evaluated for improvements to chemical and biological properties, and the development of resistance and resilience against water stress and compaction. Researchers are validating a range of test methods for quantifying resistance and resilience for field trials.

Program 4 is focusing on integrating chemical and physical solutions to constraints to soil productivity, with a strong emphasis on understanding mechanisms. Farmer group participants have provided soil samples that have multiple constraints such as sodicity, salinity, acidity or alkalinity, and low nutrient status. The information gleaned from addressing these constraints using both existing and new methods, from a largely laboratory-based project, will be used to inform future Soil CRC field trials.

There is an increased focus on helping farmers cope with drought by addressing subsoil constraints that limit root growth and access to water. Trials are specifically aiming to improve the subsoil environment, effectively increasing the 'bucket size' and improving productivity when rainfall may be limited. Constraints from residual herbicides is an important issue for optimising productivity for farmers. This project has three field trial sites and a further 15 monitoring sites to better understand and model herbicide persistence and risk under different soil types and environments.

New knowledge will be brought together with advanced computational techniques and analytical frameworks that guide soil management decisions. Researchers have improved the representation of soil phosphorous within APSIM for the major soil types in Australia and have modelled water use by weeds in fallows. While it is impossible to research and test solutions to constraints on all soils and all scenarios, by utilising data from across our projects and grower groups, the 'models' (i.e. modules within APSIM) will fill in the blanks with some degree of reliability.

Program 4 had four PhD students, with projects ranging from the improved understanding of chemical signalling between the plants and microorganisms in the rhizosphere, through to modelling herbicide persistence in sandy soils.

Program 4 Projects

PLANT BASED SOLUTIONS TO IMPROVE SOIL PERFORMANCE

4.1.002, Terry Rose, SCU, 2019-2022

Partners: CWFS, NSW DPI, Murdoch, CSU, Facey, HCPSL, Hart, RPI

This project aims to investigate how increasing species diversity in cropping systems can result in greater soil microbial abundance, fertility and disease control. It identifies crop rotations that will enable profitable integration of a range of species into farming systems that increase diversity. Long-term field sites have been established across the country – in Wagga Wagga NSW, Burramine Vic, Condobolin NSW, Hart SA, Wickepin WA and Ingham Qld. These sites will be used to assess the viability of integrating diverse species into the system as winter rotation crops, summer cover crops or perennial legumes depending on the constraints of climate, soils and weeds.

EVALUATING SOIL FUNCTIONAL RESILIENCE

4.1.003, Mehran Rezaei Rashti, Griffith, 2019-2021

Partners: Facey, HCPSL, NSW DPI

This project is assessing the resilience of soil against the environmental stresses of compaction and drought in agricultural ecosystems. It aims to provide an improved process-based understanding of relationships between compaction and drought stresses, soil ecosystem resilience and functionality and sustainable crop productivity and profitability. In the longer term, the tests and protocols produced in this project will have broader applications across Australian farmer group networks and agricultural industries. Findings so far indicate that the soil microbial metabolic activity responds differently to different levels of compaction and drought stresses – and this response also varied greatly with soil texture.

REGENERATIVE FARMING SYSTEMS

4.1.004, Gwen Grelet, Landcare NZ, 2019-2022

Partners: PIRSA, SFL, Wheatbelt NRM

This project aims to quantify the effectiveness of regenerative farming systems for improving soil performance across defined soil and climate constraints. It will promote collaboration between scientists and regenerative farmers, to study carbon functionality in regenerative farming systems and quantify key farm performance outcomes. At the core of the project is a co-innovation platform that seeks to progress relationships between researchers, farmers and extension practitioners, from engagement to collaboration. The program is investigating whether soil carbon functionality can be improved using regenerative farming practices, and whether regenerative farm management strategies increase farm performance across multiple key outcomes.

IMPROVED MANAGEMENT OF HERBICIDE RESIDUES IN SOIL

4.2.001, Michael Rose, NSW DPI, 2018-2022

Partners: Murdoch, SCU, WANTFA, EPARF, BCG

This project is addressing the issue of herbicide residue in soils, which can limit crop performance if not managed properly. Persistence and behaviour of these residues depends on numerous site-specific factors, including soil and climatic conditions. Increased weed resistance to herbicides means that many growers are increasing application doses and frequency, increasing the range of herbicides used and importantly, returning to pre-emergent residual herbicides. Growers need evidence-backed guidance on the site-specific persistence of herbicides to allow for flexible crop selection and avoidance of plant-back damage. They also need field-validated information on the potential long-term effects of herbicide residues on soil and crop health. Trial sites have been established for measuring half-lives of some pesticides under different soil conditions. Further field experiments into the discontinuing of herbicide use on soil health are ongoing – and glasshouse dose response experiments have been completed.

ADDRESSING COMPLEX SOIL CONSTRAINTS

4.2.002, Jason Condon, CSU, 2019-2021

Partners: NSW DPI, DJPR, FarmLink, CWFS, RPI, BCG, Hart, Facey

This project is addressing the issue of the management of complex soil constraints. Each constraint has an industry 'best practice' solution, but when these are applied in combination to handle multiple constraints, the input costs and practicality of application often create barriers to adoption and the constraint remains. This project is determining the mechanistic mode of action of novel soil re-engineering methods to fix complex soil constraints. It aims to facilitate increases in plant productivity and develop more resilient cropping systems. In collaboration with grower groups, the project is currently undertaking experiments on soils in New South Wales and Victoria.

OVERCOMING SOIL CONSTRAINTS IN HIGHLY CALCAREOUS SOILS

4.2.003, Nigel Wilhelm, PIRSA, 2020-2023

Partners: NSW DPI, EPARF, MFMG

With co-investment from GRDC, this project will examine soil limitations in calcareous soils in new ways and within a farming systems context—so that the outcomes will be realistic and easily implemented on farm. It will develop innovative physical and chemical management packages that are expected to include activated and nutrient enriched organic matter and chemical amendments to manipulate pH and redox potential. It will also provide information on threshold levels for constraints in highly calcareous soils and may use novel amendment products being developed in other Soil CRC projects.

IMPROVING DECISION SUPPORT SYSTEMS

4.3.002, Keith Pembleton, USQ, 2019-2021

Partners: FedUni, UTas, NSW DPI, WMG, Burdekin, BCG, RPI

This project aims to improve Decision Support Systems' ability to address complex soil constraints. It is working to improve already existing and widely used DSS through developing soil constraint modules to increase the reliability of predictions that can be used in the paddock. Testing is occurring in APSIM, Yield Prophet, ARMonline, FallowARM and Gypsy – with some modelling resulting in additions to these tools.

MANAGING SOILS FOR HIGH PERFORMANCE AFTER A DROUGHT

4.3.003, 4.3.004, Paul Petrie, PIRSA, 2020-2020

Partners: DJPR

This desktop review examined how best to manage soils after a drought. It highlighted that recovery of drought affected soils involves many aspects of farm management including basic soil literacy, understanding drought, rainfall after a drought, nutrient management, subsoil constraints, soil biology, and the management of disease, pests, weeds and herbicides.

Education and Training

The Soil CRC welcomed 14 additional PhD students during 2019-20, bringing the total number to 18.

With another 15 open PhD positions, the Soil CRC is well on the way to meeting its target of 46 PhD commencements by 2023. A second Investment Round in late 2020 and another PhD Scholarships Round in 2021 will bring this goal even closer.

Dr Cassandra Wardle was appointed as Student Coordinator (0.5 FTE) in February 2020 to develop an adaptive, needs-driven PhD Program that provides students with a 'Soil CRC experience' and supports them to develop a greater understanding of the industry to which their discipline expertise contributes.

The first annual Soil CRC Student Workshop Day was held in March. This became an online event after the COVID-19 pandemic prevented in-person activities, with ten students presenting an overview of their PhD projects in this virtual forum. Students also attended the five webinars held throughout March in lieu of the second annual Soil CRC Conference, as well as a second Soil CRC PhD Student online workshop in May and the fortnightly Soil CRC Webinar Series.

In June, the first stage of the Soil CRC PhD Hub was launched. This digital community and resource centre will function as a one-stop-shop for all Soil CRC PhD students to access forms and resources, stay up to date on Soil CRC activities, ask questions, and share information and ideas.

Most importantly, the PhD Hub supports our students to move beyond their local peer groups and connect with the broader cohort of Soil CRC PhD students. Hosted by eight universities across Australia, the students represent a range of disciplines, stages of candidature and cultural backgrounds. This cohort brings together a huge wealth of knowledge, experience, networks and capabilities from which all students can draw.

The two-year 'Building technical capacity in soil management' project, led by Felicity Harrop from North Central Catchment Management Authority (NC CMA) is co-funded by the Australian Government through the Building Landcare Community and Capacity component of the Smart Farms Program. It is delivering increased soil technical capacity and capability in grower groups, Landcare groups and NRM organisations, both within and outside of the Soil CRC.

The project is building technical capacity of these groups to deliver soil health information to farmers, by leveraging the significant skills, expertise and collaborative partnerships within the Soil CRC.

Three Communities of Practice (CoPs) have been established across Australia, each one made up of 10 participants from groups in areas of common interest.

The three CoPs cover the West – Western Australia; South – South Australia, Victoria, Tasmania and southern New South Wales; and North – northern New South Wales and Queensland.

Of the 30 groups that are represented, 15 are farmer groups and 15 are NRM organisations. Nineteen of the participants are from groups outside the Soil CRC. They have analysed the existing soil science knowledge, skills and confidence of the participants and have investigated where they currently source knowledge on soil science practice and trends.

Each of the three CoPs are developing a capacity-building plan that best addresses the gaps and needs of the individuals within each CoP and the CoP initiative as a whole. These plans will reflect the existing knowledge bases of individual participants, the needs and priorities of the groups for whom they work, the delivery needs of the projects that they are responsible for (i.e. Smart Farms projects), and the soil and farming systems issues of the region.

In the medium term, these three Communities of Practice will have positioned themselves as knowledge hubs driving adoption of sustainable, productive soil stewardship at the farm level.

A full list of Soil CRC PhD students can be found in Appendix A.

Commercialisation

Soil CRC utilisation activity increased significantly in 2019-20.

Project outputs were either being readily adopted by participants and the wider community, or providing critical guidance and direction for future research activity to be undertaken by the Soil CRC. Notable examples of significant utilisation included the following:

- Captured benchmark data of current farming practices and farmer behaviour across six regions
- Supported six participant grower groups to develop strategic innovation plans, including one amalgamation
- Identified and trained grower group innovation champions to drive change and adoption
- Increased engagement with the financial sector around soil stewardship
- Publicly released the 'Visualising Australasia's soils' data portal
- Created a framework for soil health assessment, including development and validation of test methods.

Some Soil CRC project outputs progressed towards potential commercialisation. Six projects were identified as having a potential capacity to deliver commercialised research outputs. Preliminary major achievements included the following:

- Obtaining proof of concept of (i) Smelling Soil as an indicator of soil health, (ii) a Smart Shovel measuring moisture, salinity and compaction, and (iii) wireless below ground sensors connectivity
- Synthesis of (i) nutrient-enriched biochar fertilisers, (ii) micro lime and microgypsum ameliorating materials for subsurface acidity and sodicity constraints, and (iii) novel moisture retention and microbial carrier products and technologies for field application identified
- Modification of nano-porous materials for encapsulated pesticide delivery.

To support these identified potential future commercialisation needs, the Soil CRC focused on processes to enable and support future commercialisation of outputs from research projects. A major component of this was the establishment of the Soil CRC IP management and utilisation plan. Another was the establishment of the Commercialisation and Intellectual Property Advisory Committee (CIPAC).

Soil CRC IP management and all subsequent commercialisation is aligned with the Australian Code for the Responsible Conduct of Research and the National Principles of Intellectual Property Management for Publicly Funded Research. This alignment is reflected in our governance documentation, and particularly our IP policies and IP management and utilisation plan, which were formalised and firmly established. during this year.

Intellectual Property Management

The Soil CRC recognises that intellectual property (IP) must be managed for the benefit of its participants whilst actively facilitating the dissemination and use of research outputs in Australia.

To achieve this, the Soil CRC manages IP in a manner to facilitate:

- a collaborative approach to the management, utilisation and commercialisation of IP, and
- effective and efficient dissemination, extension, adoption and commercialisation of results of research and development activities.

During the year, the Board approved the IP policies and the IP management and utilisation plan. This plan was developed to support the governing principles outlined within the IP policies, and obligations under the Soil CRC Partners Agreements and Project Agreements. The purpose of the IP management and utilisation plan is to provide guidelines to all staff, participants, researchers and students for managing IP and the process and procedures the Soil CRC will adopt in managing IP arising from its R&D investments.

The key objectives and strategies considered by the Soil CRC in managing IP include:

- establishing a project-based IP register,
- identifying and managing IP risks,
- developing clear Technology Readiness Levels (TRL) and Commercial Readiness Levels (CRL) across all projects,
- identifying options for completing ex-ante evaluation of proposed IP outcomes, and
- developing business models for high value technologies developed across projects.

Following Board approval of the IP policies and IP management and utilisation plan, all Soil CRC staff and Program Leaders completed training to understand and adhere to the processes and concepts. This training was delivered by external IP consultant, IP Active, led by Dallas Gibb. IP Active specialises in IP management and technology commercialisation services to private and government research and development organisations.

Decisions regarding the management of IP across the Soil CRC are made on a project basis, with each project being assessed for the potential value of the IP it will develop. Those projects identified for their potential to produce high value commercial IP will be managed by exception. This may include the requirement for a detailed assessment of all IP elements across such projects and could include assessment of background IP, and third-party IP.

During the year, IP Active reviewed the IP and its value of all active Soil CRC projects. From this review, six projects were identified to potentially contain high value commercial IP. These are now being managed in accordance with the IP management and utilisation plan.

The default position of the Soil CRC is that the legal and beneficial ownership of all IP generated through CRC funded activities is vested in the CRC on creation. However, in managing IP at a project level, the Soil CRC Project Agreement allows for special conditions to be developed in respect to the rights over use and ownership of IP developed from a project. In the third year of operation, many research projects indicated that they were starting to generate valuable IP. The Soil CRC recognises that there are two distinct types of IP that exist, namely non-commercial IP such as new knowledge that is to be disseminated for public good, and commercial IP that typically is an invention or tangible item that is protected by trademarks or patented. The Soil CRC does not currently hold any patents.

Collaboration has increased this year, both between our Soil CRC participants and with external organisations.

Collaboration

Collaboration remains an essential element of the Soil CRC's ongoing success.

The Soil CRC Strategic Plan 2019-2023 recognises the importance of collaboration, placing it as one of our four core values.

Throughout the Strategic Plan, collaboration is embedded into all five strategies. The most important is Strategy Four: Partnerships and Leadership, "we will actively engage our partners in all stages of planning, design, development and implementation of research activities and we will demonstrate national and international leadership in soil research".

Collaboration has increased this year, both between our Soil CRC participants and with external organisations. This is testament to the perceived value of the research outputs being delivered by the Soil CRC as being essential to soil health – and as a consequence, more people are wanting to become involved.

With projects delivering valuable research outputs, there has been increased sharing of information between our participants and the wider community through webinars, workshops, field days and even radio programs. Our unique position of having 20 grower groups as Soil CRC participants means that we can directly and rapidly share this information throughout rural Australia. Equally as important, researchers can readily access and acquire critical input information and guidance from these 20 grower groups and our industry partners about ongoing and emerging issues they are facing, as well as obtain real time feedback on adoptability of future technologies and source valuable field data.

One example that demonstrates our collaboration success is the 'Visualising Australasia's soil' data portal that now contains approximately 24,000 datasets, mainly provided by Soil CRC participants. This is a valuable decision-making tool providing farmers, agronomy practitioners, agricultural researchers and agribusinesses with relevant place-based information on demand via an online platform.

To facilitate collaborations between research and industry participants, the Soil CRC has firmly established a culture where the opinions and contributions of industry participants are highly valued in research projects.

For example, for a proposal to be eligible for consideration and investment by the Soil CRC, it must include at least two CRC participants and address questions about the extent of end-user engagement, as well as route to market and pathway to adoption, and the quality of the project team including the extent of collaboration. Proposals are assessed and ranked by the Research and Adoption Committee, whose membership includes researchers and end-users.

In June 2020, the Soil CRC entered into a collaborative investment with the Grains Research and Development Corporation (GRDC) to investigate the management of calcareous soils in southern Australia. As a result, the 'Overcoming soil constraints in highly calcareous soils' project was initiated. The Soil CRC was also contracted by the Australian Government's Department of Agriculture, Water and Environment (DAWE) to deliver a project under the National Landcare Program's Smart Farms Program to build soil technical capacity in natural resource management (NRM) and grower groups. This project has enabled Soil CRC researchers and industry participants to further collaborate with non-participant grower groups, Landcare groups and NRM organisations within the CRC and beyond, across all states of Australia.

SME Engagement

Engagement with Small to Medium Enterprises (SMEs) is a key focus area for the Soil CRC, as more than half of the CRC's participants are SMEs.

One of our key values, as stated in the Soil CRC Strategic Plan 2019-2023, is to be "end user driven and focussed".

During this year, there was increased engagement with all our participants as we commenced a formal review of the Commonwealth milestones. This involved many program meetings and discussions within the steering committees and project teams. It is through this extensive engagement that we can be confident that the changes proposed are supported by our participants and reflect the current and emerging landscape with the challenges and opportunities facing Australian agriculture.

Overall, though, this has been a very challenging year for engagement activities, with flooding, bush fires and the COVID-19 pandemic impacting many of our SME stakeholders. Our researchers have experienced unexpected difficulty in reaching farmers and SMEs, such as restrictions on travel.

However, they have also used this period to observe and redesign their engagement strategies.

Our established means of engagement may have been challenged this year, and will be into the next year, but we are still focussed on facilitating the delivery of publications, technical reports, fact sheets and newsletters – and hosting and participating in meetings, workshops and field days with our participants and non-participants.

Many face to face meetings have been replaced by video meetings with the added benefit of increased attendance due to reduced travel commitments.

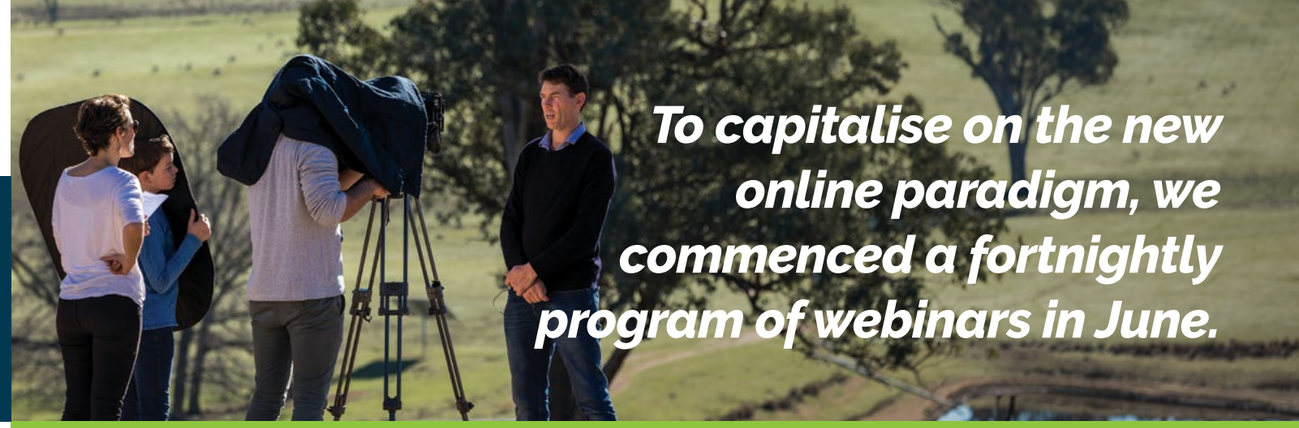
Following the launch of the Soil CRC Strategic Plan 2019-2023, we began developing a communications and engagement strategy. It is expected that this strategy will be completed and Board endorsed early in the next year. This will enable the Soil CRC to rapidly and effectively disperse the research outputs that are steadily growing through our research activities.

During this year, the Soil CRC has increased its engagement with SMEs. This has included the following:

- Inviting key geographically located SME stakeholders to informally meet with Board members and to present to the Board during their meetings
- Updating the Soil CRC Participants capability and contacts compendium, which is used as a guide for SMEs and Project Leaders when forming concepts for new research proposals
- Delivering online webinars on our research, which has attracted extensive interest from stakeholders working for SMEs.

SMEs are directly represented on the Board and in the Research and Adoption Committee (RAC). Board Director Dr Stephen Carr currently manages Aglime of Australia and Precision SoilTech in Western Australia and is on the Board as a representative of the Facey Group and as a nominee from the Associates Collective. RAC members include Mr Chris Sounness, who is the Wimmera Development Association's Executive Director in Victoria, and Dr Neil Ballard, who is a legume inoculation specialist who owns Global Pasture Consultants in Western Australia.

Communications



EMAIL NEWSLETTERS

The Soil CRC newsletter is delivered every second month to a growing database of over 1000 subscribers that include both CRC participants and those with an interest in the CRC. Six newsletters were sent in 2019-20, in which we profiled our researchers, farmer groups and research organisations and provided project updates and general Soil CRC news. Engagement is strong, with high open and click through rates for the newsletter.

The CEO informs participants of Soil CRC organisational activities through regular CEO Communiques. Seven CEO Communiques were delivered to over 550 participants in 2019-20.

SOCIAL MEDIA

The Soil CRC social media channels of Twitter, LinkedIn and YouTube continue to grow in followers and subscribers. We use these channels to share updates from our projects, upcoming events, items from the newsletter and any other Soil CRC news. We also use them to amplify our research and spotlight our participants' work in soil research.

WEBSITE

Traffic to the Soil CRC website continues to grow, with strong interest in the 2019 Year in Review section and news pages of the website – and session time has remained strong. The website continues to evolve, with an upgrade to the navigation improving accessibility. We have also added an events page, a page for webinars, an education and training menu, and a jobs page.

PARTICIPANTS CONFERENCE

The second annual Soil CRC Participants Conference was scheduled to be held in Adelaide in March 2020. Due to the COVID-19 pandemic, the conference had to be cancelled. In lieu of the conference, we held four webinars, which included a presentation from each of our Program Leaders and two project leaders from each Program. These were well attended and are available to view on the Soil CRC website. An online PhD workshop and milestone review meetings were also held.

WEBINARS

To capitalise on the new online paradigm, we commenced a fortnightly program of webinars in June. Each webinar is presented by one of our project leaders and concludes with a question and answer session. This provides a great opportunity to engage with our participants and those members of the general public interested in our research. Every webinar is available on our website.

MEDIA

With more research underway, our media coverage has increased. Some of the projects that received media coverage were the 'Application of liquid biosolids', 'Regenerative farming systems', 'Smelling soil', 'Visualising Australasia's soils', 'Plant based solutions to improved soil performance' and 'Surveying farm practices'.

SPONSORSHIPS

Sponsorship of conferences and events continues to play an important part in our communications strategy. We sponsored the following conferences and events:

- 7th International Symposium on Soil Organic Matter
- Australian Agronomy Conference
- Australian Fertilizer Industry Conference
- Australian Farm Institute's Valuing Agriculture's Natural Capital Roundtable
- WA Soil Science Conference
- Talkin' Soil Health (WA).

These conferences provided a great opportunity to raise the awareness of the Soil CRC and to meet face to face with many of our participants, enabling valuable two-way communications.

COMMUNICATIONS AND ENGAGEMENT STRATEGY

In March 2020, the Soil CRC engaged Currie Communications to produce a Communications and Engagement Strategy. The purpose of the strategy is to implement and deliver on communications and engagement aspects of the Soil CRC Strategic Plan 2019-2023. It will direct and prioritise the communications and stakeholder engagement activities of the Soil CRC, led by the Communications Manager, but involving all Soil CRC staff.

COMMUNITY SUPPORT

The Soil CRC was approached by Thankful4Farmers, a collaborative initiative bringing together industries, brands, influencers and consumers in a united effort to raise awareness and generate revenue to support sustainable agriculture and regional communities across Australia.

Along with a number of leading Australian food and hospitality brands, we now have a collaborative memorandum of understanding that assists with cross-promotion.

Led by chef and restaurateur Matt Moran as Ambassador, Thankful4Farmers is committed to funding initiatives that address systemic challenges facing agriculture and rural communities in Australia. Our CEO, Dr Michael Crawford, is on the Australian Advisory Council of Thankful4Farmers.

Risks and Impediments

The Soil CRC continued to utilise its established risk management systems and processes, with governance oversight provided by the Audit and Risk Management Committee (ARMC) of the Board.

Our use of best management practices for risk management was reflected in the Soil CRC Strategic Plan 2019-2023 under Strategy Five – Governance and Management. As part of these practices, risks are reviewed regularly, which involves identification, analysis and treatment. A major output of the Soil CRC risk management process is the risk register that captures risk identification, prioritisation and management. The risk register is formally reviewed each quarter or as required.

During this year, the ARMC was satisfied with the risk register and found the 14 risks identified were being managed acceptably. The ARMC discussed the effect of the COVID-19 pandemic on the CRC and requested that a separate risk register be created for monitoring and managing COVID-19 related risks.

COVID-19 poses a significant risk as it could lead to research programs not achieving outcomes, Commonwealth milestones not being met, and projects requiring additional resources to deliver output. Of particular concern were the restrictions on the entry of international PhD students to Australia to commence their candidature, and the continued employment of research staff positions by organisations under financial stress imposed by COVID-19.

Other key risk management activities for the year included:

- completion of the business continuity and risk controls review for the Soil CRC computer systems and applications and subsequent migration of all files to SharePoint as recommended, and
- implementation of the Intellectual Property Management System and training of all Soil CRC staff and Program Leaders to ensure protection of IP as it is used and created within the CRC.

The Soil CRC continued to manage the commitments to the Commonwealth Funding Agreement with an area of focus being participant in-kind contributions. The CRC undertook an internal review of all reported participant commitments during the year and commenced plans to upgrade the project management system that captures this information.

The Soil CRC was fully compliant in its management and governance with the CRC Constitution, the Commonwealth Funding Agreement, the Participant Agreements and all relevant laws and regulations.

Work continued on developing and approving a range of policies and procedures to ensure consistency, transparency, integrity and good governance in all aspects of the CRC's business.

Governance Board, Committees and Key Staff

SOIL CRC STRUCTURE

The Soil CRC is an incorporated company limited by guarantee. It is registered as a not for profit public company that is not listed. It is governed by its constitution and reports to its members. All Major Partners are eligible to be a member of the company and as at 30 June 2020, all eleven Major Partners are members.

The company has a board of nine directors, one of whom acts as Chair. There are five independent and four non-independent directors. On 29 April 2020, the Commercialisation and Intellectual Property Advisory Committee was formed, taking the number of committees to five. They govern Research, Risk, Nominations, Remuneration, Intellectual Property and Commercialisation. The CEO reports to the Board on the management of the Soil CRC. The CEO has a team that reports to him to operate the Soil CRC. The company has an ATO private ruling that confirms the company is income tax exempt and an FBT rebatable employer.

PATRON

The inaugural Patron of the Soil CRC, Major General the Hon. Michael Jeffery AC, AO (Mil), CVO, MC (Retd) stepped down from his role as Patron in June 2020, due to an ongoing medical condition.

Following an illustrious military career, General Jeffery served as the Governor-General of Australia from 2003 to 2008. In 2012, he was appointed by the Prime Minister as Australia's Advocate for Soil Health.

As National Soils Advocate, he worked tirelessly to raise public and political awareness of the critical role soil plays in underpinning sustainable productivity, delivering high quality ecosystem services and helping to meet global challenges – including food security and climate change.

General Jeffery played an important role in 2016 in ensuring the Soil CRC bid was successful. He acted as an advisor to the bid team and was a critical part of the team that presented verbally to the assessment panel, with General Jeffery delivering the closing arguments. With that background, the Board had no hesitation in inviting him to be the Patron of the Soil CRC. As Patron, he continued to promote the objectives and capabilities of the CRC, whilst also providing valuable input to its directions and activities.

Upon relinquishing the role, General Jeffery said he was "so pleased to become the first Patron of the Soil CRC as I am so proud of all that you are achieving".

The Soil CRC is immensely grateful for the leadership and support that General Jeffery has provided, both as National Soils Advocate and as Patron of the Soil CRC.

THE BOARD

The Soil CRC is governed by a skills-based Board of Directors with an independent Chair and a majority of independent directors. The Board provides oversight of the Soil CRC activities, performance and strategic direction and takes responsibility for establishing, maintaining and monitoring an appropriate level of governance in relation to the core tasks of the Company.

Independent Directors are appointed by the Board from recommendations made by the Nominations and Selection Committee. Three non-independent Directors are provided by the Major Partners. One non-independent Director is provided by either the Partner or Associate collectives. All appointments are subject to confirmation by the members of the company.

As per the Constitution, the four longest serving Directors resigned at the 2019 Annual General Meeting. Appointments were made in accordance with the Members voting for two positions of Non-Independent Directors, representing Major Partners, one position of Non-Independent Director, representing the Partner and Associate Collectives, and the reappointment of one Independent Director for a further term.

GOVERNANCE BOARD, COMMITTEES AND KEY STAFF

DIRECTORS

Name	Role	Appointed	Number of meetings held while in office	Number of meetings attended
Paul Greenfield	Independent Chair	10 July 2017	6	6
Andrea Bishop	Non-independent Director	27 November 2019	3	2
Malcolm Buckby	Non-independent Director	4 May 2017	6	5
Steve Carr	Non-independent Director	27 November 2019	3	3
Kevin Hall[1]	Non-independent Director	4 May 2017	3	1
Ralph Hardy	Independent Director	28 June 2017	6	6
Anna Lavelle	Independent Director	14 September 2017	6	6
Kate Lorimer-Ward	Non-independent Director	17 January 2018	6	5
Robbie Sefton	Independent Director	26 July 2017	6	6
Roger Swift	Independent Director	10 July 2017	6	6

[1]Until 27 November 2019

BOARD MEETINGS

Board meetings were held at locations associated with our participant organisations, or by teleconference until mid-March 2020. Since COVID-19 travel restrictions came into force, meetings have been held by video conference. Despite being unable to hold Board meetings at different locations across Australia, meeting with and supporting (virtually) our participants across Australia continues to be a priority.

Number	Date	Location
1	29 August 2019	Primary Industries and Regions SA (PIRSA), Adelaide
2	2 October 2019	Teleconference
3	27 November 2019	University of Newcastle, Sydney Campus
4	26 February 2020	University of Southern Queensland, Toowoomba
5	29 April 2020	Videoconference
6	28 May 2020	Videoconference

Directors

Name	Board Position	Key Skills
Dr Paul Greenfield AO FTSE 	**Chair** Independent	Dr Paul Greenfield is a chemical engineer with extensive experience as a Board Director on company and CRC boards. He was awarded an Order of Australia in 2006 for services to science and engineering. He was Vice-Chancellor of the University of Queensland, is currently Chair of the International Water Centre, and is on the Board of the Great Barrier Reef Foundation.
Prof. Andrea Bishop 	**Director** Griffith University	Professor Andrea Bishop is the Pro Vice Chancellor Research at Griffith University. She holds a PhD in Physical Chemistry as well as postgraduate qualifications in education and business; and has been awarded for her contributions in education practice, development and delivery. Previous appointments have included deputy to the Dean of Science and Director of Research at Charles Sturt University. Andrea is currently a Non-Executive Director of the CRC Association Board and Griffith Enterprise Advisory Board.
Malcolm Buckby 	**Director** South Australian Grains Industry Trust	Malcolm Buckby is a Project Manager for the South Australian Grain Industry Trust (SAGIT). He was the Manager for the Rural Services Office of the Royal Agricultural and Horticultural Society of South Australia until 31 December 2018 and now consults to them. Malcolm brings a strong knowledge of agricultural issues to the Board.
Stephen Carr 	**Director** Facey Group	Dr Stephen Carr has over 35 years' experience working in agricultural research and development in the government, university and private sectors. He has a PhD in soil chemistry from the University of Western Australia, and for the past 17 years has managed Aglime of Australia and Precision SoilTech – playing a major role in understanding the extent and severity of soil acidity in Western Australia, and then managing this limitation.
Prof. Kevin Hall 	**Director** University of Newcastle	Professor Kevin Hall is the Senior Deputy Vice-Chancellor and Vice-President Global Engagement and Partnerships at the University of Newcastle. Professor Hall's research career focussed on water quality modelling, development of environmental monitoring, syndromic surveillance, and water and health in marginalised communities.

Name	Board Position	Key Skills
Ralph Hardy 	**Director** Independent	Ralph Hardy is a director and senior manager with extensive finance, commercial, and systems experience in the manufacturing and service industries. He currently leads multinational finance teams for the Ampcontrol Group. Ralph is also a Director of CRC CARE.
Dr Anna Lavelle FTSE 	**Director** Independent	Dr Anna Lavelle has over 25 years' experience serving on Boards. From 2005 to 2016, she was the CEO of AusBiotech. Dr Lavelle has a PhD in Genetics from the University of Melbourne and is a Graduate of the Australian Institute of Company Directors (GAICD). She is the Independent Chair of Medicines Australia and serves on a number of other Boards.
Kate Lorimer-Ward 	**Director** NSW Department of Primary Industries	Kate Lorimer-Ward has high level strategic planning and corporate governance skills. She is a Deputy Director-General, with the NSW Department of Primary Industries and Chief Executive to the NSW Rural Assistance Authority – and she has extensive knowledge of agriculture and agricultural communities from her roles in the NSW public sector over the past 25 years.
Robbie Sefton 	**Director** Independent	Robbie Sefton is the Managing Director of strategic communication company Seftons and a farmer of wool, meat and grains in northern NSW. Robbie is also Chair of the Murray Darling Basin Authority's Socio-Economic Assessment Panel and Deputy Chair of the National Australia Day Council, and has sat on advisory panels for the Australian Taxation Office, the Reserve Bank of Australia and Woolworths.
Prof. Roger Swift FTSE 	**Director** Independent	Professor Roger Swift is Emeritus Professor of Soil Science at the University of Queensland. He has held a number of academic and research positions in soil science and agriculture including as Chief of the CSIRO Division of Soils. Professor Swift is a world-renowned, extensively-published soil scientist and was a long-serving Board member of the International Union of Soil Sciences.

GOVERNANCE BOARD, COMMITTEES AND KEY STAFF

AUDIT AND RISK MANAGEMENT COMMITTEE (ARMC)

The primary purpose of the ARMC is to assist the Board in fulfilling its responsibilities relating to the accounting and reporting practices of the Company – and to provide oversight in respect of the risk management activities of the Company.

The ARMC met on five occasions in 2019-20.

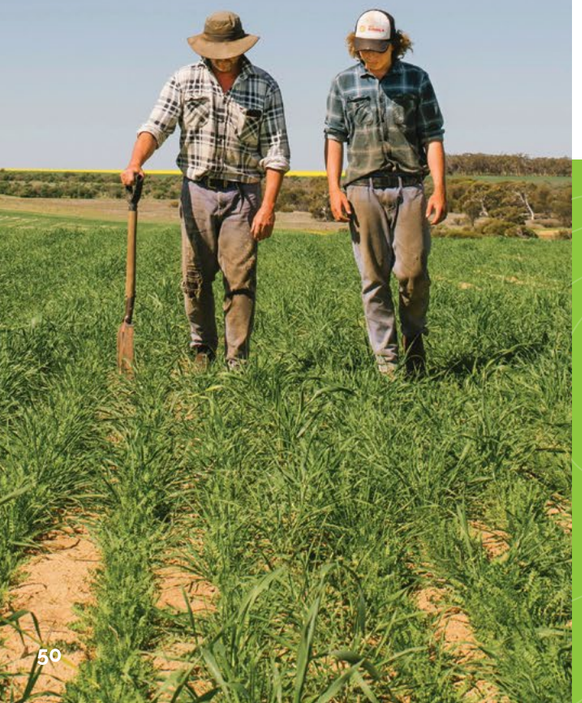
COMMERCIALISATION AND INTELLECTUAL PROPERTY ADVISORY COMMITTEE (CIPAC)

The primary role of the CIPAC is to oversee the intellectual property and commercialisation activities of the Company. The CIPAC was established on 29 April 2020 and did not meet in 2019-20.

NOMINATIONS AND SELECTION COMMITTEE (NSC)

The NSC meets on an as-needs basis to make recommendations regarding the appointment of the Chair, the CEO and Directors.

One meeting was held in 2019-20.



REMUNERATION COMMITTEE

The purpose of the Remuneration Committee is to give the Board comfort that:

- executives occupying senior management positions within the Company receive sufficient incentive to motivate enhanced performance and that they are fairly rewarded for their individual contributions to the Company's overall performance having due regard to the interests of the shareholders and the financial position of the Company,
- levels of remuneration are sufficient to attract and retain executives of the quality required to successfully manage the Company, and
- a succession plan is in place for the Company, noting that some of the key individuals may not be in the direct employ of the Company.

The Remuneration Committee met on one occasion in 2019-20. The Remuneration Committee membership was revised on 29 April 2020

Name	Audit and Risk Management Committee	Commercialisation and Intellectual Property Advisory Committee[1]	Nomination and Selection Committee	Remuneration Committee
Andrea Bishop	Director[1]			Director[1]
Malcolm Buckby			Director	
Paul Greenfield		Director[1]	Chair	Chair
Kevin Hall				Director[2]
Ralph Hardy	Chair			
Anna Lavelle		Chair[1]		
Kate Lorimer-Ward	Director		Director[1]	
Robbie Sefton	Director	Director[1]		
Roger Swift			Director	Director

[1]From 29 April 2020
[2]Until 27 November 2019

GOVERNANCE BOARD, COMMITTEES AND KEY STAFF

RESEARCH AND ADOPTION COMMITTEE (RAC)

The primary role of the RAC is to provide oversight of the research, adoption and education activities of the Soil CRC – and to review and advise the Board and the CEO on proposals for project funding.

Name	Role	Key Skills
Roger Swift	Chair, Director, Researcher	See Board description
Michael Crawford	CEO	
Neil Ballard	Independent End User	Farmer, seed grower, consultant, Western Australia
Malcolm Buckby[1]	Director	See Board description
Stephen Carr[1]	Director	See Board description
Hong Di	International Researcher	Professor of Soil and Environmental Science, Lincoln University, New Zealand
Anna Lavelle[2]	Director	See Board description
Ann McNeill	Australian-based Researcher	Adjunct Associate Professor, University of Adelaide, South Australia
Chris Sounness	Independent End User	CEO, Wimmera Development Association

[1]Joined 29 April 2020
[2]Until 29 April 2020

The RAC met on four occasions in 2019-20. The RAC membership was revised on 29 April 2020.

COMPANY SECRETARY

Company Secretary services are provided to the Company by an external organisation, CooperConsult, specifically Nick Baldock and Catherine Cooper.

GENDER DIVERSITY OF THE SOIL CRC

Board: 4 female, 5 male

Management: 2 female, 2 male

Program Leaders: 1 female, 3 male

Staff: 6 female, 2 male

Staff of the Soil CRC

Staff

Name	Organisation	CRC Position / role	Time commitment (FTE)
Dr Michael Crawford	Soil CRC	Chief Executive Officer	1.0
Millicent Crowe[1]	Soil CRC	Research Administration Officer	1.0
Mark Flick[2]	Soil CRC	Finance Manager	0.5
Jodi McLean	Soil CRC	Operations Manager	1.0
Julie Moulton[3]	Soil CRC	Research Administration Officer	1.0
Chris Murphy[4]	Soil CRC	Business Development Manager	Consultant
Katherine Seddon	Soil CRC	Communications Manager	0.8
Kathy Stokes	Soil CRC	Executive Assistant	1.0
Dr Cassandra Wardle[5]	Soil CRC	Student Coordinator	0.5
Jessie Xu[2]	Soil CRC	Finance Officer	0.4

Program Leaders[6]

Name	Organisation	CRC Position / role	Time commitment (FTE)
Assoc. Prof. Catherine Allan	Charles Sturt University	Program 1 Leader	0.5
Assoc. Prof. Richard Doyle	University of Tasmania	Program 2 Leader	0.5
Prof. Nanthi Bolan	University of Newcastle	Program 3 Leader	0.5
Dr Lukas Van Zwieten	NSW Department of Primary Industries	Program 4 Leader	0.5

[1]Left 8 November 2019.
[2]Mark Flick and Jessie Xu are employed by CRC CARE Pty Ltd and provide support to the Soil CRC under a Shared Financial Services agreement.
[3]Commenced 14 November 2019.
[4]Chris Murphy was first engaged in March 2019 and provides services on an ad hoc basis as required.
[5]Commenced 25 February 2020.
[6]Program Leaders are provided by their host organisation as an in-kind contribution to the Soil CRC.

Financial Management

The Soil CRC depends on the continued support of its participants and the Australian Government for its ongoing operations.

During the 2019-20 financial year, 77% of the Company's contributions (cash and in-kind) were provided by participants and 23% from the Australian Government.

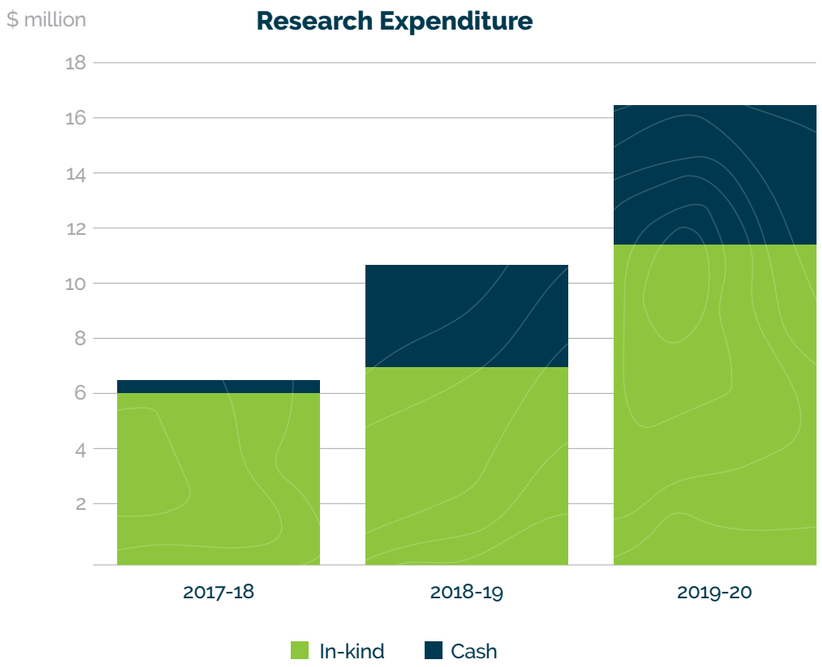
The Company had invoiced all the contracted participants for their cash contributions for the year ended 30 June 2020. Receivables at year end included the Commonwealth quarterly payment, accrued as paid in arrears, which formed the majority, and one participant who still owed their current quarter's contributions.

Overall, the Soil CRC is in a strong financial position with $7.9m in cash to be applied to its future project commitments.

The Company's in-kind contributions exceeded the Funding Agreement targets in the financial year. However, this good result should be viewed in the context of the Soil CRC lifecycle as timing of these contributions are linked to the major project work that has expanded and will continue to increase in future years.

In 2019-20, research expenditure-cash increased from $3,474,574 (2018-19) to $4,848,702.

The graph below indicates the increase in the CRC's research expenditures:



The overall financial performance of the Soil CRC is on track to allow the CRC to achieve its milestones for the activities within the committed contribution levels. Financial management strategies during the 2019-20 financial year included maintaining tight cost control and seeking additional participant and external contributions.

As with all CRCs, the continuing financial sustainability of the Soil CRC and its ability to support existing and new projects are dependent on the Company being successful in:

- receiving the continuing support of its participants and the Australian Government,
- securing additional funding where appropriate, and
- achieving sufficient future cash flows to enable its obligations to be met.

The Directors believe that the Company will be successful in the above matters and, accordingly, the accounts have been prepared on a going concern basis.

The overall financial management of the Soil CRC is provided by way of a shared financial services arrangement with CRC CARE Pty Ltd. The shared financial service is led by the Finance Manager, Mark Flick a Chartered Accountant, and assisted by the Finance Officer, Jessie Xu, a CPA. By leveraging the synergy of CRC CARE, the Company has continued to reduce administration costs whilst freeing up executive time.

The recent independent audit of the company noted that there were no control issues or material recommendations for improvement identified during the 2020 audit process. Financial reports are delivered to management monthly, and quarterly financial reports are presented to the Board and its Audit and Risk Management Committee.

The independent auditor's report to the members of the Soil CRC for the financial year ending 30 June 2020 has expressed the opinion that the financial report of Soil CRC has been prepared in accordance with the Corporations Act 2001 and is unmodified. Their opinion further states that the financial report as at 30 June 2020 gives a true and fair view of the Company's financial position as at that date and of its performance for the period ended on that date, and complies with Australian Accounting Standards.

Other Activities

CRC future plans and transition arrangements

In the first three years of the Soil CRC, the focus has been on:

- establishing the structures and processes to ensure we deliver the agreed outputs over the 10-year life of the Soil CRC, and
- identifying and commencing project activities to maximise the utilisation of these outputs by our participants, collaborators and end-users.

Consequently, not much attention has been specifically directed towards post-CRC activity (2027 onwards), but this will have an increased focus as the Soil CRC progresses.

Monitoring and review activity update

The Soil CRC has not been subject to monitoring or review during the reporting period.

Activities not covered by the Funding Agreement

In 2019-20, the Soil CRC delivered a project for the Department of Agriculture, Water and Environment titled Building Technical Capacity in Soil Management, as detailed elsewhere in this report. The Soil CRC also entered into a co-invested project with the Grains Research and Development Corporation (GRDC) to investigate innovative solutions for low crop performance on highly calcareous soils.

There have been no other activities of any great consequence undertaken by the Soil CRC during the reporting period outside of the activities covered by the Funding Agreement—and there were no activities linking to Industry Growth Centres.

Financial Report

CRC for High Performance Soils Limited

ACN 618 897 224

Financial Statements

For the Year Ended 30 June 2020

DIRECTORS' REPORT

30 June 2020

The directors present their report on CRC for High Performance Soils Limited for the financial year ended 30 June 2020.

Directors

The names of the directors in office at any time during, or since the end of, the year are:

Name	Position	Appointed/Resigned
Paul Greenfield	Chair	
Andrea Gaye Bishop	Director	Appointed 27 November 2019
Anna Lavelle	Director	
Kate Alexandra Lorimer-Ward	Director	
Kevin Hall	Director	Resigned 27 November 2019
Malcolm Robert Buckby	Director	
Ralph Hardy	Director	
Robbie Sefton	Director	
Roger Samuel Swift	Director	
Stephen John Carr	Director	Appointed 27 November 2019

Directors have been in office since the start of the financial year to the date of this report unless otherwise stated.

Principal activities

The principal activity of CRC for High Performance Soils Limited during the financial year was to fund research programs, to help farmers bridge the gap between soil science and farm management—giving them the tools and knowledge to make decisions on complex soil management issues.

No significant changes in the nature of the Company's activity occurred during the financial year.

Members' guarantee

CRC for High Performance Soils Limited is a company limited by guarantee. In the event of, and for the purpose of winding up of the company, the amount capable of being called up from each member and any person or association who ceased to be a member in the year prior to the winding up, is limited to $100 for members that are corporations and $100 for all other members, subject to the provisions of the company's constitution.

At 30 June 2020 the collective liability of members was $1,100 (2019: $1,000).

DIRECTORS' REPORT cont.

Review of operations

The Company specialises in research and development of technologies to provide farmers with knowledge and tools they need to make decisions on extremely complex soil management issues. During the year, the Company received cash contributions of $6,052,250 (2019: $6,369,000) and in-kind contributions of $11,495,214 (2019: $7,023,574).

Events after the reporting date

No matters or circumstances have arisen since the end of the financial year which significantly affected or could significantly affect the operations of the Company, the results of those operations or the state of affairs of the Company in future financial years.

Future developments and results

Likely developments in the operations of the Company and the expected results of those operations in future financial years have not been included in this report as the inclusion of such information is likely to result in unreasonable prejudice to the Company.

Auditor's independence declaration

The lead auditor's independence declaration in accordance with section 307C of the *Corporations Act 2001*, for the year ended 30 June 2020 has been received and can be found on page 59 of the financial report.

Signed in accordance with a resolution of the Board of Directors:

Chairman: _____

Paul Greenfield

Director: _____

Ralph Hardy

Dated: 30 September 2020

AUDITOR'S INDEPENDENCE DECLARATION UNDER SECTION 307C OF THE CORPORATIONS ACT 2001

I declare that, to the best of my knowledge and belief, during the year ended 30 June 2020, there have been:

(i) no contraventions of the auditor independence requirements as set out in the Corporations Act 2001 in relation to the audit; and

(ii) no contraventions of any applicable code of professional conduct in relation to the audit.

PKF
Chartered Accountants

Martin Matthews
Partner

Newcastle, NSW

Dated: 30 September 2020

PKF(NS) Audit & Assurance Limited Partnership
ABN 91 850 861 839

Liability limited by a scheme approved under Professional Standards Legislation

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Newcastle West NSW 2302 Australia
PO Box 2368 Dangar NSW 2309
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STATEMENT OF PROFIT OR LOSS AND OTHER COMPREHENSIVE INCOME

For the Year Ended 30 June 2020

	Note	2020 $	2019 $
Revenue	4	**17,324,989**	11,458,982
Other income	4	**133,694**	96,440
Consultants fees		**(77,892)**	(56,272)
Employee benefits expense		**(490,652)**	(400,989)
Finance expenses		**(823)**	(730)
IT expenses		**(113,423)**	(103,665)
Legal expenses		**(8,214)**	(2,694)
Other expenses	5	**(396,969)**	(454,123)
Research expenditure – cash		**(4,848,702)**	(3,474,574)
Research expenditure – in-kind		**(11,495,214)**	(7,023,000)
Travel expenses		**(26,794)**	(39,375)
Surplus before income tax		**-**	-
Income tax expense	2(i)	**-**	-
Surplus for the year		**-**	-
Other comprehensive income for the year		**-**	-
Total comprehensive income for the year		**-**	-

The accompanying notes form part of these financial statements.

STATEMENT OF FINANCIAL POSITION

As at 30 June 2020

	Note	2020 $	2019 $
Assets			
Current assets			
Cash and cash equivalents	6	**7,876,909**	8,066,456
Trade and other receivables	7	**1,211,417**	1,029,451
Other assets		**50,039**	48,454
Total current assets		**9,138,365**	**9,144,361**
Total non-current assets		**-**	**-**
Total assets		**9,138,365**	**9,144,361**
Liabilities			
Current liabilities			
Trade and other payables	8	**1,628,947**	2,042,352
Employee benefits		**53,381**	19,133
Other financial liabilities	9	**7,456,037**	7,082,876
Total current liabilities		**9,138,365**	**9,144,361**
Total non-current liabilities		**-**	**-**
Total liabilities		**9,138,365**	**9,144,361**
Net assets		**-**	**-**
Equity			
Retained earnings		**-**	-
Total equity		**-**	-

The accompanying notes form part of these financial statements.

FINANCIAL REPORT

STATEMENT OF CHANGES IN EQUITY

For the Year Ended 30 June 2020

2020	Retained Earnings $	Total $
Balance at 1 July 2019	-	-
Surplus for the financial year	-	-
Balance at 30 June 2020	-	-

2019	Retained Earnings $	Total $
Balance at 1 July 2018	-	-
Surplus for the financial year	-	-
Balance at 30 June 2019	-	-

STATEMENT OF CASH FLOWS

For the Year Ended 30 June 2020

	Note	2020 $	2019 $
Cash flows from operating activities			
Cash contributions received from Commonwealth (inclusive of GST)		**4,595,800**	3,823,104
Cash contributions received from Participants (inclusive of GST)		**2,185,700**	3,109,950
Payments to suppliers and employees		**(7,103,918)**	(3,635,120)
Interest received		**133,694**	96,440
Finance costs		**(823)**	(730)
Net cash provided by operating activities	13	**(189,547)**	3,393,644
Cash flows from investing activities			
Net cash provided by/(used in) investing activities		**-**	-
Cash flows from financing activities			
Net cash provided by/(used in) investing activities		**-**	-
Net increase in cash and cash equivalents held		**(189,547)**	3,393,644
Cash and cash equivalents at beginning of year		**8,066,456**	4,672,812
Cash and cash equivalents at end of financial year	6	**7,876,909**	8,066,456

The accompanying notes form part of these financial statements.

NOTES TO THE FINANCIAL STATEMENTS

For the Year Ended 30 June 2020

The financial report covers CRC for High Performance Soils Limited as an individual entity. CRC for High Performance Soils Limited is a not-for-profit Company limited by guarantee, incorporated and domiciled in Australia.

The functional and presentation currency of CRC for High Performance Soils Limited is Australian dollars..

1 Basis of Preparation

In the Directors' opinion, the Company is not a reporting entity since there are unlikely to exist users of the financial statements who are not able to command the preparation of reports tailored so as to satisfy specifically all of their information needs. This special purpose financial report has been prepared to meet the reporting requirements of the *Corporations Act 2001*.

The financial statements have been prepared in accordance with the recognition and measurement principles of all applicable Australian Accounting Standards and Interpretations issued by the Australian Accounting Standards Board and the *Corporations Act 2001*.

2 Summary of Significant Accounting Policies

(a) Revenue and other income

Revenue from contracts with customers

For current year

The core principle of AASB 15 is that revenue is recognised on a basis that reflects the transfer of promised goods or services to customers at an amount that reflects the consideration the Company expects to receive in exchange for those goods or services. Revenue is recognised by applying a five-step model as follows:

1. Identify the contract with the customer
2. Identify the performance obligations
3. Determine the transaction price
4. Allocate the transaction price to the performance obligations
5. Recognise revenue as and when control of the performance obligations is transferred

Generally the timing of the payment for sale of goods and rendering of services corresponds closely to the timing of satisfaction of the performance obligations, however where there is a difference, it will result in the recognition of a receivable, contract asset or contract liability.

None of the revenue streams of the Company have any significant financing terms as there is less than 12 months between receipt of funds and satisfaction of performance obligations.

Specific revenue streams

The revenue recognition policies for the principal revenue streams of the Company are:

Grant revenue

Government grants are over time as the research and project outputs are performed.

Government grants relating to costs which have not yet been incurred are included in deferred revenue in current liabilities and are credited to the statement of comprehensive income in the period necessary to match them with the costs that they are intended to compensate.

Participants' contributions

Contributions received in cash (recorded as deferred revenue on receipt – for further information refer note 9) and in-kind from the Participants during the financial year are applied to expenditure incurred in carrying out the affairs of the Company under the terms of the Participants Agreement between the Company and the entities who have undertaken to provide contributions to the Company (other than the Commonwealth of Australia).

Contributions as detailed in note 15 are calculated on a cash basis for reporting purpose to Commonwealth of Australia.

(b) In-kind contributions

In-kind contributions of staff by research providers are valued in accordance with the Commonwealth Agreement, as per Table 1 of the Schedule 4 of the Agreement.

Non-staff in-kind contributions are valued on the following bases:

1. Buildings – a reasonable estimate of the commercial rental value related to the area and time period of occupation related to the activities of the Company.
2. Capital equipment – either an allocation of the replacement cost of the equipment apportioned over the proportion of the useful life utilized by the activities of the Company or an agreed value determined with reference to the cost of an equipment service from a commercial operator.

Office accommodation is provided by the University of Newcastle as part of the Participants Agreement and are treated as in-kind contributions. Where a value cannot be readily obtained by applying the policy rules set out above, a Directors' valuation is used.

(c) Cash and cash equivalents

Cash and cash equivalents comprises cash on hand, deposits held at call with financial institutions, other short term, highly liquid investments with original maturities of three months or less that are readily convertible to known amounts of cash and which are subject to an insignificant risk of changes in value.

(d) Financial instruments

Financial assets

Financial instruments are recognised initially on the date that the Company becomes party to the contractual provisions of the instrument.

On initial recognition, all financial instruments are measured at fair value plus transaction costs (except for instruments measured at fair value through profit or loss where transaction costs are expensed as incurred).

The financial assets of the Company have been reclassified into one of the following categories on adoption of AASB 9 based on primarily the business model in which a financial asset is managed and its contractual cash flow characteristics:

- Measured at amortised cost
- Fair value through profit or loss (FVTPL)
- Fair value through other comprehensive income – debt instruments (FVOCI – debt)
- Fair value through other comprehensive income – equity instruments (FVOCI – equity).

Trade receivables

Trade receivables are recognised initially at fair value and subsequently measured at amortised cost, less provision for expected credit losses. Trade receivables are due for settlement no more than 30 days.

The amount of the impairment is recorded in a separate allowance account with the loss being recognised in finance expense. Once the receivable is determined to be uncollectable then the gross carrying amount is written off against the associated allowance.

Financial liabilities

The Company measures all financial liabilities initially at fair value less transaction costs, subsequently financial liabilities are measured at amortised cost using the effective interest rate method.

(e) Impairment of assets

Assets that are subject to depreciation or amortisation are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An impairment loss is recognised for the amount by which the asset's carrying amount exceeds its recoverable amount. The recoverable amount is the higher of an asset's fair value less costs to sell and value in use. For the purposes of assessing impairment, assets are grouped at the lowest levels for which there are separately identifiable cash flows (cash generating units).

(f) Trade Creditors

All trade creditors unpaid as at the reporting date are recognised at the amount invoiced, net of any applicable taxes. The Company's policy is to pay trade creditors no more than 30 days from the date of invoice.

(g) Employee benefits

(i) Wages and salaries, annual leave and sick leave

Liabilities for wages and salaries, including non-monetary benefits, accumulating sick leave and annual leave expected to be settled within 12 months of the reporting date are recognised in respect of employee's services up to the reporting date and are measured at the amounts expected to be paid when the liabilities are settled.

Liabilities for non-accumulating sick leave are recognised when the leave is taken and measured at the rates paid or payable.

(ii) Long service leave

The liabilities for long service leave and annual leave are not expected to be settled wholly within 12 months after the end of the period in which the employees render the related service. They are therefore measured as the present value of expected future payments to be made in respect of services provided by employees up to the end of the reporting period using the projected unit credit method. Consideration is given to expected future wage and salary levels, experience of employee departures and periods of service.

Expected future payments are discounted using market yields at the end of the reporting period of corporate bonds with terms and currencies that match, as closely as possible, the estimated future cash outflows. Remeasurements as a result of experience adjustments and changes in actuarial assumptions are recognised in profit or loss.

(h) Research expenditure

Research expenditure are recognised as incurred and consist of costs incurred as part of day to day research and development activities for research programs. The main items of expenditure are salaries, equipment, consumables and travel costs.

Salaries relate to research and non-research staff working directly on research programs. In some instances salary costs may be allocated between research expenditure and employee benefits when it is identified that time can be specifically attributed to research programs.

(i) Income Tax

The Company is exempt from income tax under Division 50 of the *Income Tax Assessment Act 1997*.

3 Critical Accounting Estimates and Judgments

The preparation of financial statements requires the use of certain critical accounting estimates. It also requires management to exercise its judgement in the process of applying the Company's accounting policies. Estimates and judgements are continually evaluated and are based on historical experience and other factors, including expectation of future events that may have a financial impact on the entity and that are believed to be reasonable under the circumstances.

The areas involving a higher degree of judgement or complexity, or areas where assumptions or estimates are significant to the financial statements are detailed below.

Key estimates – revenue recognition – long term contracts

The Company undertakes long term contracts which span a number of reporting periods. Recognition of revenue in relation to these contracts involves estimation of future costs of completing the contract and the expected outcome of the contract. The assumptions are based on the information available to management at the reporting date, however future changes or additional information may mean the expected revenue recognition pattern has to be amended.

Key estimates – in-kind contributions

Staff contributions are valued in accordance with guidelines and the multiplier set by the Commonwealth of Australia and as detailed in note 2(a). The actual time recorded on project work requires a certain level of estimate and judgement by project leaders. In applying that judgement, consideration is given to project budgets and agreements, as set out and approved by Participants and the Company.

The capital and equipment rates and useful lives used for contributions are based on estimations and agreements as calculated by project Participants and the Company. Valuations are generally based on estimates of the percentage utilisation of capital and equipment depreciation directly related to project output.

The Company believes that the estimates and assumptions in relation to in-kind contributions result in recognition of amounts that represent the fair value of contributions received.

NOTES TO THE FINANCIAL STATEMENTS cont.

For the financial period ended 30 June 2020

4 Revenue and other income

Revenue from continuing operations

	2020 $	2019 $
Contributions revenue		
Allocated contributions from Commonwealth/ Participants—cash	**5,829,775**	4,435,982
Allocated contributions from Participants—in-kind	**11,495,214**	7,023,574
Total contributions revenue	**17,324,989**	**11,459,556**
Other income		
Interest	**133,694**	96,440
Total other income	**133,694**	96,440
Total revenue and other income	**17,458,683**	**11,555,996**

5 Other expenses

Board expenses	**233,333**	288,592
Insurance	**29,363**	27,579
Compliance fees	**26,295**	18,012
Communications and Marketing	**44,513**	43,629
Other expenses	**63,465**	76,311
Total	**396,969**	454,123

6 Cash and cash equivalents

	2020 $	2019 $
Bank balances	**719,521**	2,499,802
Deposits at call	**7,157,388**	5,566,654
Total	**7,876,909**	**8,066,456**

7 Trade and other receivables

Current		
Trade receivables	**1,107,751**	1,029,451
GST receivable	**103,666**	-
Total	**1,211,417**	**1,029,451**

8 Trade and other payables

Current		
Trade payables	**433,051**	370,920
GST payable	**26,934**	107,428
Accrued expenses	**1,168,962**	1,564,004
Total	**1,628,947**	**2,042,352**

9 Other Financial Liabilities

Current		
Contributions from Commonwealth and Participants	**6,981,810**	6,658,649
Other deferred revenue	**474,227**	424,227
Total	**7,456,037**	**7,082,876**

As per the accounting policy in note 2, contributions from the Commonwealth of Australia and Participants (both cash and in-kind) are treated as deferred revenue until matched against expenditure in the course of the Company's activities.

In the event of a wind up of the Company, any deferred revenue not matched against expenditure is required to be returned to the Commonwealth of Australia and individual Participants in accordance with the terms of the Agreements.

Deferred revenue arising from obligations to make contributions to the Company and not allocated to program expenses at balance date has been included as a current liability as it is anticipated that the relevant sum will be matched against expenditure during subsequent financial years.

10 Members' guarantee

The Company is incorporated under the *Corporations Act 2001* and is a Company limited by guarantee. If the Company is wound up, the constitution states that each member is required to contribute a maximum of $100 each towards meeting any outstandings and obligations of the Company. At 30 June 2020 the number of members was 11 (2019: 10).

11 Auditors' remuneration

	2020 $	2019 $
Remuneration of the auditor PKF, for:		
Auditing the financial statements	**20,500**	19,450
Total	**20,500**	**19,450**

12 Contingencies

In the opinion of the Directors, the Company did not have any contingencies at 30 June 2020 (30 June 2019: None).

13 Cash flow information

(a) Reconciliation of result for the year to cashflows from operating activities

	2020 $	2019 $
Reconciliation of surplus to net cash provided by operating activities		
Surplus for the year	**-**	-
Changes in assets and liabilities:		
– increase in trade and other receivables	**(181,967)**	(241,451)
– increase in other current assets	**(1,584)**	(40,832)
– increase in deferred revenue	**373,161**	3,361,697
– (decrease)/increase in trade and other payables	**(413,405)**	311,514
– increase in employee benefits	**34,248**	2,716
Cashflows from operations	**(189,547)**	**3,393,644**

14 Events occurring after the reporting date

The financial report was authorised for issue on 30 September 2020 by the board of directors.

No matters or circumstances have arisen since the end of the financial year which significantly affected or may significantly affect the operations of the Company, the results of those operations, or the state of affairs of the Company in future financial years.

NOTES TO THE FINANCIAL STATEMENTS cont.

For the financial period ended 30 June 2020

15 Participants' contributions

(Cash basis ex GST as per note 2(a))

	2020 $	2019 $	2018 $	Total $
Australian Organics Recycling Association Limited				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**12,500**	87,500	7,500	107,500
Other	**-**	2,000	-	2,000
Total	**12,500**	89,500	7,500	109,500

	2020 $	2019 $	2018 $	Total $
Birchip Cropping Group Inc				
Cash contributions	**5,000**	5,000	5,000	15,000
In-kind contributions				
Staff	**62,500**	150,000	55,000	267,500
Other	**42,676**	3,000	8,650	54,326
Total	**110,176**	158,000	68,650	336,826

	2020 $	2019 $	2018 $	Total $
Burdekin Productivity Services Limited				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**50,000**	27,500	15,000	92,500
Other	**6,750**	-	1,000	7,750
Total	**56,750**	27,500	16,000	100,250

	2020 $	2019 $	2018 $	Total $
Central West Farming Systems Inc				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**62,500**	55,000	130,000	247,500
Other	**69,155**	10,000	23,535	102,690
Total	**131,655**	65,000	153,535	350,190

	2020 $	2019 $	2018 $	Total $
Charles Sturt University				
Cash contributions	**200,000**	200,000	200,000	600,000
In-kind contributions				
Staff	**682,500**	480,000	345,000	1,507,500
Other	**359,526**	8,000	3,600	371,126
Total	**1,242,026**	688,000	548,600	2,478,626

	2020 $	2019 $	2018 $	Total $
Corrigin Farm Improvement Group				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**-**	-	5,000	5,000
Other	**-**	-	-	-
Total	**-**	-	5,000	5,000

	2020 $	2019 $	2018 $	Total $
Department of Jobs, Precincts and Regions (VIC)				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**100,000**	437,500	385,000	922,500
Other	**88,726**	5,000	199,000	292,726
Total	**188,726**	442,500	584,000	1,215,226

	2020 $	2019 $	2018 $	Total $
Department of Regional NSW				
Cash contributions	**-**	450,000	75,000	525,000
In-kind contributions				
Staff	**540,000**	435,000	595,000	1,570,000
Other	**390,662**	22,000	308	412,970
Total	**930,662**	907,000	670,308	2,507,970

	2020 $	2019 $	2018 $	Total $
Department of Primary Industries and Regions (SA)				
Cash contributions	**100,000**	100,000	100,000	300,000
In-kind contributions				
Staff	**137,500**	67,500	60,000	265,000
Other	**239,808**	3,000	5,805	248,613
Total	**477,308**	170,500	165,805	813,613

	2020 $	2019 $	2018 $	Total $
Eyre Peninsula Agricultural Research Foundation Inc				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**42,500**	27,500	10,000	80,000
Other	**38,788**	-	2,000	40,788
Total	**81,288**	27,500	12,000	120,788

	2020 $	2019 $	2018 $	Total $
Facey Group Inc				
Cash contributions	**5,000**	5,000	5,000	15,000
In-kind contributions				
Staff	**147,500**	250,000	250,000	647,500
Other	**5,000**	3,000	8,500	16,500
Total	**157,500**	258,000	263,500	679,000

	2020 $	2019 $	2018 $	Total $
FarmLink Research Limited				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**2,500**	30,000	20,000	52,500
Other	**4,473**	4,000	5,000	13,473
Total	**6,973**	34,000	25,000	65,973

	2020 $	2019 $	2018 $	Total $
Federation University Australia				
Cash contributions	**100,000**	100,000	100,000	300,000
In-kind contributions				
Staff	**240,000**	500,000	500,000	1,240,000
Other	**169,689**	80,000	80,000	329,689
Total	**509,689**	680,000	680,000	1,869,689

	2020 $	2019 $	2018 $	Total $
Griffith University				
Cash contributions	**100,000**	100,000	100,000	300,000
In-kind contributions				
Staff	**640,000**	305,000	160,000	1,105,000
Other	**449,870**	56,000	67,803	573,673
Total	**1,189,870**	461,000	327,803	1,978,673

	2020 $	2019 $	2018 $	Total $
Hart Field Site Group Incorporated				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**25,000**	12,500	15,000	52,500
Other	**42,000**	-	-	42,000
Total	**67,000**	12,500	15,000	94,500

	2020 $	2019 $	2018 $	Total $
Herbert Cane Productivity Services Limited				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**65,000**	45,000	12,500	122,500
Other	**54,108**	-	4,000	58,108
Total	**119,108**	45,000	16,500	180,608

NOTES TO THE FINANCIAL STATEMENTS cont.

For the financial period ended 30 June 2020

15 Participants' contributions cont.

(Cash basis ex GST as per note 2(a))

	2020 $	2019 $	2018 $	Total $
Holbrook Landcare Group				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**10,000**	10,000	15,000	35,000
Other	**85**	1,000	1,463	2,548
Total	**10,085**	11,000	16,463	37,548

	2020 $	2019 $	2018 $	Total $
Murdoch University				
Cash contributions	**150,000**	113,000	150,000	413,000
In-kind contributions				
Staff	**340,000**	175,000	30,000	545,000
Other	**344,918**	-	6,250	351,168
Total	**834,918**	288,000	186,250	1,309,168

	2020 $	2019 $	2018 $	Total $
South Australian Grain Industry Trust Fund				
Cash contributions	**150,000**	150,000	150,000	450,000
In-kind contributions				
Staff	**17,500**	12,500	10,000	40,000
Other	**7,500**	-	-	7,500
Total	**175,000**	162,500	160,000	497,500

	2020 $	2019 $	2018 $	Total $
Society of Precision Agriculture Australia (SPAA)				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**5,000**	10,000	52,500	67,500
Other	**500**	-	-	500
Total	**5,500**	10,000	52,500	68,000

	2020 $	2019 $	2018 $	Total $
Landcare Research (New Zealand)				
Cash contributions	**267,000**	267,000	267,000	801,000
In-kind contributions				
Staff	**35,000**	85,000	135,000	255,000
Other	**1,800**	5,000	2,777	9,577
Total	**303,800**	357,000	404,777	1,065,577

	2020 $	2019 $	2018 $	Total $
North Central Catchment Management Authority				
Cash contributions	**15,000**	-	-	15,000
In-kind contributions				
Staff	**17,500**	120,000	27,500	165,000
Other	**7,000**	5,000	-	12,000
Total	**39,500**	125,000	27,500	192,000

	2020 $	2019 $	2018 $	Total $
South East Water Corporation				
Cash contributions	**30,000**	30,000	30,000	90,000
In-kind contributions				
Staff	**125,000**	85,000	80,000	290,000
Other	**-**	6,000	150,000	156,000
Total	**155,000**	121,000	260,000	536,000

	2020 $	2019 $	2018 $	Total $
The Gillamii Centre				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**-**	-	2,500	2,500
Other	**-**	-	-	-
Total	**-**	-	2,500	2,500

	2020 $	2019 $	2018 $	Total $
MacKillop Farm Management Group Inc				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**2,500**	7,500	5,000	15,000
Other	**1,000**	-	-	1,000
Total	**3,500**	7,500	5,000	16,000

	2020 $	2019 $	2018 $	Total $
Nutrien Ag Solutions				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**90,000**	187,500	232,500	510,000
Other	**52,300**	6,000	2,250	60,550
Total	**142,300**	193,500	234,750	570,550

	2020 $	2019 $	2018 $	Total $
Southern Cross University				
Cash contributions	**200,000**	200,000	200,000	600,000
In-kind contributions				
Staff	**840,000**	682,500	655,000	2,177,500
Other	**601,269**	159,000	13,563	773,832
Total	**1,641,269**	1,041,500	868,563	3,551,332

	2020 $	2019 $	2018 $	Total $
The Liebe Group Inc				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**-**	12,500	12,500	25,000
Other	**-**	-	-	-
Total	**-**	12,500	12,500	25,000

	2020 $	2019 $	2018 $	Total $
Mallee Sustainable Farming Inc				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**-**	15,000	7,500	22,500
Other	**-**	-	250	250
Total	**-**	15,000	7,750	22,750

	2020 $	2019 $	2018 $	Total $
Riverine Plains Incorporated				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**30,000**	3,700	17,500	51,200
Other	**25,000**	-	-	25,000
Total	**55,000**	3,700	17,500	76,200

	2020 $	2019 $	2018 $	Total $
Southern Farming Systems Limited				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**7,500**	15,000	12,500	35,000
Other	**10,118**	11,000	5,838	26,956
Total	**17,618**	26,000	18,338	61,956

	2020 $	2019 $	2018 $	Total $
The Trustee for Soils for Life Trust				
Cash contributions	**20,000**	20,000	20,000	60,000
In-kind contributions				
Staff	**85,000**	70,000	5,000	160,000
Other	**18,250**	3,000	3,709	24,959
Total	**123,250**	93,000	28,709	244,959

NOTES TO THE FINANCIAL STATEMENTS cont.

For the financial period ended 30 June 2020

15 Participants' contributions cont.

(Cash basis ex GST as per note 2(a))

	2020 $	2019 $	2018 $	Total $
The University of Newcastle				
Cash contributions	**300,000**	300,000	300,000	900,000
In-kind contributions				
Staff	**765,000**	1,030,000	530,643	2,325,643
Other	**935,620**	172,000	96,000	1,203,620
Total	**2,000,620**	1,502,000	926,643	4,429,263

	2020 $	2019 $	2018 $	Total $
University of Southern Queensland				
Cash contributions	**150,000**	150,000	150,000	450,000
In-kind contributions				
Staff	**390,000**	217,500	417,500	1,025,000
Other	**314,211**	8,000	35,595	357,806
Total	**854,211**	375,500	603,095	1,832,806

	2020 $	2019 $	2018 $	Total $
University of Tasmania				
Cash contributions	**187,500**	113,000	150,000	450,500
In-kind contributions				
Staff	**735,000**	470,000	285,000	1,490,000
Other	**609,479**	15,000	30,000	654,479
Total	**1,531,979**	598,000	465,000	2,594,979

	2020 $	2019 $	2018 $	Total $
Western Australian No Tillage Farmers Association				
Cash contributions	**10,000**	10,000	10,000	30,000
In-kind contributions				
Staff	**50,000**	110,000	100,000	260,000
Other	**28,337**	-	-	28,337
Total	**88,337**	120,000	110,000	318,337

	2020 $	2019 $	2018 $	Total $
West Midlands Group Incorporated				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**12,500**	7,500	-	20,000
Other	**4,000**	-	-	4,000
Total	**16,500**	7,500	-	24,000

	2020 $	2019 $	2018 $	Total $
Wheatbelt Natural Resource Management Incorporated				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**52,500**	52,500	57,500	162,500
Other	**42,211**	12,000	12,000	66,211
Total	**94,711**	64,500	69,500	228,711

	2020 $	2019 $	2018 $	Total $
Wimmera Catchment Authority				
Cash contributions	**-**	-	-	-
In-kind contributions				
Staff	**92,500**	112,300	152,500	357,300
Other	**17,816**	23,000	15,181	55,997
Total	**110,316**	135,300	167,681	413,297

	2020 $	2019 $	2018 $	Total $
Other Third Party				
Cash contributions	**-**	480,000	-	480,000
In-kind contributions				
Staff	**-**	-	-	-
Other	**-**	-	-	-
Total	**-**	480,000	-	480,000

	2020 $	2019 $	2018 $	Total $
Total Participant Contribution				
Cash contributions	**1,989,500**	2,793,000	2,012,000	6,794,500
In-kind contributions				
Staff	**6,512,500**	6,401,000	5,408,143	18,321,643
Other	**4,982,714**	622,000	784,077	6,388,791
Total	**13,484,714**	9,816,000	8,204,220	31,504,934

	2020 $	2019 $	2018 $	Total $
Total Commonwealth Contribution				
Cash contributions	**4,062,750**	3,576,000	3,422,000	11,060,750
In-kind contributions				
Staff	**-**	-	-	-
Other	**-**	-	-	-
Total	**4,062,750**	3,576,000	3,422,000	11,060,750

	2020 $	2019 $	2018 $	Total $
Total Contributions				
Cash contributions	**6,052,250**	6,369,000	5,434,000	17,855,250
In-kind contributions				
Staff	**6,512,500**	6,401,000	5,408,143	18,321,643
Other	**4,982,714**	622,000	784,077	6,388,791
Total	**17,547,464**	13,392,000	11,626,220	42,565,684

NOTES TO THE FINANCIAL STATEMENTS cont.

For the financial period ended 30 June 2020

16 Commitments for Expenditure

	2020 $	2019 $
Payable within 1 year	**3,873,793**	3,855,447
Payable greater than 1 year but less than 5 years	**3,494,667**	6,887,527
Total Commitments	**7,368,460**	10,742,974

At balance date the entity had the following commitments for expenditure:

- Funding obligations in relation to research projects that are relevant to the Company's obligations under the terms of the Commonwealth Agreement. The sum of the cash obligations is $7,298,041 (2019: $10,682,298).
- Funding obligations for the secondment of employees to provide services to the Company. The total sum of the obligations are $70,419 (2019: $60,676).

17 Statutory Information

The registered office and principal place of business of the company is:

CRC for High Performance Soils Ltd
Level 1, IDC Building
University of Newcastle
University Drive Callaghan NSW 2308

DIRECTORS' DECLARATION

The directors have determined that the Company is not a reporting entity and that these special purpose financial statements should be prepared in accordance with the accounting policies described in Note 2 of the financial statements.

The directors of the Company declare that:

1. The financial statements and notes, as set out on pages 60 to 74, are in accordance with the *Corporations Act 2001* and:

(a) comply with Australian Accounting Standards as stated in Note 1; and

(b) give a true and fair view of the financial position as at 30 June 2020 and of the performance for the year ended on that date in accordance with the accounting policy described in Note 2 of the financial statements.

2. In the directors' opinion, there are reasonable grounds to believe that the Company will be able to pay its debts as and when they become due and payable.

This declaration is made in accordance with a resolution of the Board of Directors.

Chairman: _____

Paul Greenfield

Director: _____

Ralph Hardy

Dated: 30 September 2020

INDEPENDENT AUDIT REPORT

To the members of CRC for High Performance Soils Limited

Report on the Audit of the Financial Report

Opinion

We have audited the financial report, being a special purpose financial report of CRC for High Performance Soils Limited (the Company), which comprises the statement of financial position as at 30 June 2020, the statement of profit or loss and other comprehensive income, the statement of changes in equity and the statement of cash flows for the year then ended, and notes to the financial statements, including a summary of significant accounting policies, and the directors' declaration.

In our opinion, the accompanying financial report of the Company is in accordance with the *Corporations Act 2001*, including:

(i) giving a true and fair view of the Company's financial position as at 30 June 2020 and of its financial performance for the year ended; and

(ii) complying with Australian Accounting Standards to the extent described in Note 1 and the *Corporations Regulations 2001*.

Basis for Opinion

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the Auditor's Responsibilities for the Audit of the Financial Report section of our report.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Emphasis of Matter—Basis of Accounting

We draw attention to Note 1 to the financial report, which describes the basis of accounting. The financial report has been prepared for the purpose of fulfilling the directors' financial reporting responsibilities under the *Corporations Act 2001*. As a result, the financial report may not be suitable for another purpose. Our opinion is not modified in respect of this matter.

Independence

We are independent of the Company in accordance with the auditor independence requirements of the Corporations Act 2001 and the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110 Code of Ethics for Professional Accountants (including Independence Standards) (the Code) that are relevant to our audit of the financial report in Australia. We have also fulfilled our other ethical responsibilities in accordance with the Code.

We confirm that the independence declaration required by the Corporations Act 2001, which has been given to the directors of the Company, would be in the same terms if given to the directors as at the time of the auditor's report.

Responsibilities of Directors for the Financial Report

The directors of the Company are responsible for the preparation of the financial report that gives a true and fair view and have determined that the basis of preparation described in Note 1 to the financial report is appropriate to meet the requirements of the Corporations Act 2001 and is appropriate to meet the needs of the members. The directors' responsibility also includes such internal control as the directors determine necessary to enable the preparation of a financial report that gives a true and fair view and is free from material misstatement, whether due to fraud or error.

In preparing the financial report, the directors are responsible for assessing the Company's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the directors either intend to liquidate the Company or to cease operations, or have no realistic alternative but to do so.

Auditor's Responsibilities for the Audit of the Financial Report

Our objectives are to obtain reasonable assurance about whether the financial report as a whole is free from material misstatement, whether due to fraud or error,

INDEPENDENT AUDIT REPORT

To the members of CRC for High Performance Soils Limited

and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with Australian Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of the financial report.

As part of an audit in accordance with the Australian Auditing Standards, we exercise professional judgement and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial report, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Company's internal control.
- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the directors.
- Conclude on the appropriateness of the directors' use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Company's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial report or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Company to cease to continue as a going concern.
- Evaluate the overall presentation, structure and content of the financial report, including the disclosures, and whether the financial report represents the underlying transactions and events in a manner that achieves fair presentation.

We communicate with the directors regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

We also provide the directors with a statement that we have complied with relevant ethical requirements regarding independence, and to communicate with them all relationships and other matters that may reasonably be thought to bear on our independence, and where applicable, action taken to eliminate threats or safeguards applied.

PKF Chartered Accountants

Martin Matthews Partner

Newcastle, NSW

Dated: 30 September 2020

PhD Students 2019-20

Name	University	Primary Supervisor	Title	Start	Expected Finish	Country of Origin
Mathew Alexanderson	Southern Cross University	Hanabeth Luke	Regenerative agriculture: exploring the boundaries of an alternative agricultural system	2019	2022	Australia
Melissa Wales	Charles Sturt University	Catherine Allan	Social norms of soil management	2019	2022	Australia
Louise Hunt	Southern Cross University	Hanabeth Luke	Negotiating the complexities of farming in the 21st century	2020	2023	Australia
Darren West	University of Tasmania	Marcus Hardie	Development of smart soil moisture sensors through machine learning soil parameters	2018	2022	United Kingdom
Ben Buurman	Federation University Australia	Joarder Kamruzzaman	Longer-range soil moisture sensing using signal propagation characteristics	2019	2022	Australia
Jaye Hill	University of Southern Queensland	John Bennett	Proximal soil nutrient sensing using integrated electrochemical sensing	2019	2022	Australia
Reuben Mah	University of Tasmania	Michael Breadmore	Colorimetric reagents and mobile application for analysing NPKS and micronutrients	2019	2022	Malaysia
Phillip Kay	University of Tasmania	Morag Glen	Microbial changes associated with improved or reduced soil health	2019	2022	Australia
Arnab Mitra	University of Tasmania	Marcus Hardie	Mobile soil water extraction for biological and chemical analysis	2020	2023	India
Md Zahangir Hossain	University of Newcastle	Nanthi Bolan	Biochar and nutrient interactions	2017	2020	Bangladesh
Aminur Rahman	University of Newcastle	Dane Lamb	Phosphorus mobilisation from biochar from plant root systems	2017	2020	Bangladesh
Sepide Abbasi	University of Newcastle	Megh Mallavarapu	Phosphorus acquisition from organic amendments	2017	2020	Australia
Rahat Shabir	Griffith University	Chengrong Chen	Developing effective biochar and biopolymer material as an alternative microbial carrier	2019	2022	Pakistan
Cobi Vrenegoor	Griffith University	Maryam Esfandbod	Improving understanding of soil organic carbon functionalities to optimise composts and improve soil productivity	2020	2023	Australia
Xiangyu Liu	Griffith University	Chengrong Chen	Developing sensitive soil health indicators of Australian agricultural land	2018	2021	China
Cameron Copeland	Southern Cross University	Terry Rose	Influence of root exudates on soil microbial diversity and soil function	2019	2022	Australia
Win Win Pyone	Murdoch University	Richard Bell	Managing phytotoxicity of soil-borne herbicide residues in grain cropping systems	2019	2022	Myanmar
Hanlu Zhang	University of Southern Queensland	Afshin Ghahramani	Soil-moisture profile dynamics affected by cover crop: Effect of changes in soil biology and structure	2020	2023	China

APPENDIX B

Participants and third parties

Soil CRC Participant Organisation	ABN	Abbreviation	Organisation Type
Australian Organics Recycling Association Limited	17 158 519 736	AORA	Individual SME
Birchip Cropping Group Incorporated	92 087 981 510	BCG	Individual SME
Burdekin Productivity Services Limited	18 107 846 060	Burdekin	Individual SME
Central West Farming Systems Incorporated	37 814 703 505	CWFS	Individual SME
Charles Sturt University	83 878 708 551	CSU	University
Corrigin Farm Improvement Group	73 411 548 004	CFIG	Individual SME
Department of Jobs, Precincts and Regions (Vic)	83 295 188 244	DJPR	State government
Department of Regional NSW (previously Department of Primary Industries (NSW))	72 189 919 072	NSW DPI	State government
Department of Primary Industries and Regions (SA)	53 763 159 658	PIRSA	State government
Eyre Peninsula Agricultural Research Foundation Incorporated (now Agricultural Innovation and Research Eyre Peninsula)	94 833 615 975	EPARF	Individual SME
Facey Group Incorporated	59 136 484 550	Facey	Individual SME
FarmLink Research Limited	23 109 837 505	FarmLink	Individual SME
Federation University Australia	51 818 692 256	Fed Uni	University
Griffith University	78 106 094 461	Griffith	University
Hart Field Site Group Incorporated	72 015 164 228	Hart	Individual SME
Herbert Cane Productivity Services Limited	71 100 551 826	HCPSL	Individual SME
Holbrook Landcare Group	64 092 836 658	Holbrook	Individual SME
Mackillop Farm Management Group Incorporated	60 685 776 966	MFMG	Individual SME
Mallee Sustainable Farming Incorporated	99 557 839 332	MSF	Individual SME
Manaaki Whenua Landcare Research (New Zealand) Limited		Landcare NZ	Other
Murdoch University	61 616 369 313	Murdoch	University
NSW Environment Protection Authority	43 692 285 758	NSW EPA	State government
North Central Catchment Management Authority	73 937 058 422	NC CMA	Individual SME
Nutrien Ag Solutions Limited (previously Landmark Operations Limited)	73 008 743 217 (same)	Nutrien	Industry
Riverine Plains Incorporated	95 443 809 873	RPI	Individual SME
Society of Precision Agriculture Australia Incorporated	43 553 215 627	SPAA	Individual SME
Soils For Life Trust	23 744 512 660	SFL	Individual SME
South Australian Grain Industry Trust Fund	23 116 814 640	SAGIT	Individual SME
South East Water Corporation	89 066 902 547	SEW	Industry
Southern Cross University	41 995 651 524	SCU	University
Southern Farming Systems Limited	54 093 170 631	SFS	Individual SME
The Gillamii Centre Incorporated	16 887 295 206	Gillamii	Individual SME
The Liebe Group Incorporated	44 748 432 382	Liebe	Individual SME
The University of Newcastle	15 736 576 735	UON	University
University of Southern Queensland	40 234 732 081	USQ	University
University of Tasmania	30 764 374 782	UTas	University
West Midlands Group Incorporated	47 325 820 894	WMG	Individual SME
Western Australian No-tillage Farmers Association (Incorporated)	33 038 818 613	WANTFA	Individual SME
Wheatbelt Natural Resource Management Incorporated	61 661 518 664	Wheatbelt NRM	Individual SME
Wimmera Catchment Management Authority	83 900 830 261	Wimmera CMA	Individual SME

Third Party Organisation	ABN	Organisation Type
Department of Agriculture, Water and Environment	24 113 085 695	Australian Government
Eyre Peninsula NRM	81 927 209 608	Individual SME
Grains Research and Development Corporation	55 611 223 291	Individual SME
National Australia Bank Limited	12 004 044 937	Industry
Royal Melbourne Institute of Technology (RMIT)	49 781 030 034	University
WA Composts Pty Ltd (C-Wise)	97 962 521 954	Individual SME

APPENDIX C

Publications

Refereed Journal Papers

Allan, C. (2019) The opportunities and risks of the Soil Security metaphor: A Review. Sustainability, 11(16), 4464. doi.org/10.3390/su11164464

Hardie, M. & Hoyle, D. (2019) Underground Wireless Data Transmission Using 433-MHz LoRa for Agriculture. Sensors, 19(19), 4232. doi.org/10.3390/s19194232

Other Publications

Bell, R., Rose, M., McGrath, G. & Minkey, D. (2020) Improved management of herbicide residues in soil. Talkin' Soil Health Conference, 11-13 March 2020, York, WA, 6301

Burns, S. (2020) Sweet smelling soils evaluated. The Land, published 29 April 2020. North Richmond NSW 2754

Burns, S. (2020) Investigating the aroma of healthy soils. The Land, published 18 June 2020. North Richmond NSW 2754

Condon, J. (2019) Mechanistic understanding of the mode of action of novel soil reengineering methods for complex chemical and physical constraints. FarmLink Research Report 2019. FarmLink, Temora, NSW 2666

Cook, A. (2019) Developing knowledge and tools to better manage herbicide residues in soil. Minnipa Agricultural Centre Field Day 19 September 2019 Booklet. South Australian Research and Development Institute (SARDI) & Eyre Peninsula Agricultural Research Foundation (EPARF). Wudinna, SA, 5652

Curtis, A. & Luke, H. (2019). Social benchmarking for natural resource management: 2019 North Central Victoria. Southern Cross University, NSW, 2480. ISBN 978-1-64826-349-1.

Dahlhaus, P. (2019) Visualising Australia's Soils Project Newsletter December 2019. Centre for eResearch and Digital Innovation (CeRDI), Mount Helen, VIC 3350

Dahlhaus, P. (2019) VAS Portal. data.soilcrc.com.au/map/about. Cooperative Research Centre for High Performance Soils, Newcastle, NSW, Australia

Dahlhaus, P.G. (2019) Visualising Australasia's Soils: A Soil CRC interoperable spatial knowledge system. Governance and Data Stewardship Guidelines. Discussion Paper. Soil CRC Project 2.3.001. Cooperative Research Centre for High Performance Soils, Newcastle, NSW, Australia

Hardie, M. (2019) Smart Soil Sensors. FarmLink Research Report 2019. FarmLink, Temora, NSW 2666

Harrop, F. (2020) Project Update: Building technical capacity. Soil CRC Newsletter February 2020. Cooperative Research Centre for High Performance Soils, Newcastle, NSW, Australia

Higgins, V. (2020) Understanding adoptability of techniques and practices for improved soil management. Summary of Progress for Farming Groups. March 2020. University of Tasmania, TAS, 7005

Higgins, V. (2020) Why do farmers adopt soil management practices? Soil CRC Newsletter April 2020. Cooperative Research Centre for High Performance Soils, Newcastle, NSW, Australia

Lamb, D. (2019) Project Update: Recovering nutrients from organic waste streams. Soil CRC Newsletter April 2020. Cooperative Research Centre for High Performance Soils, Newcastle, NSW, Australia

Lobsey, C., Tavakkoli, E., Dimos, N. & Crawford, M. (2020) Are we treating soil like dirt? EvokeAg Conference Melbourne. AgriFutures, Wagga Wagga, NSW 2650

Luke, H. (2019) Project Update: Surveying farm practices. Soil CRC News. Cooperative Research Centre for High Performance Soils, Newcastle, NSW, Australia

Luke, H. (2020) How can a survey help build resilience for Australian Farmers? Southern Cross University Engagement Latest News. SCU, Lismore, NSW 2480

Luke. H. (2020) What drives farmers to choose their farming method? Soil CRC Newsletter April 2020. Cooperative Research Centre for High Performance Soils, Newcastle, NSW, Australia

Nuruzzaman, Md., Liu, Y. & Naidu. R. (2019) Interaction of Surface Activated Halloysite Nanotube with Imidacloprid. CRC CARE 2019, 8th International Contaminated Site Remediation Conference incorporating the 2nd International PFAS Conference: Program and Proceedings, CleanUp 2019 Conference, Adelaide, Australia, 8-12 September 2019

Orgill, S. (2019) Soil constraints in Australian agriculture: Research priorities and approaches. NSW Department of Primary Industries Southern NSW Research Results 2019 (DPI Southern Trials Booklet)

Parvin, S., Schefe, C., Condon, J., Rose, T., et al. (2019) Understanding the mechanisms that affect soil microbial functions upon rhizosphere modification by intercropping in legume/cereal system. Natural Product Symposium, Charles Sturt University, Wagga Wagga Campus, 3-4 October 2019, CSU, Wagga Wagga, NSW, 2650

Parvin, S., Schefe, C., Condon, J. & Rose, T. (2019) Increasing plant species diversity in cropping systems. Riverine Plains Incorporated Trial Book. Research for the Riverine Plains 2019. A selection of research relevant to agriculture in the Riverine Plains. RPI, Mulwala, NSW 2647

Powell, S. (2019) Smelling Soil. FarmLink Research Report 2019. FarmLink, Temora, NSW 2666

Rose, M., Van Zwieten, L. & Angel, K. (2020) Trial Report (Field Research). 2019 BCG Season Research Results Compendium. Birchip Cropping Group, Birchip, VIC, 3483

Rose, M., Cook, A. & Van Zwieten, L. (2020) Persistence of the herbicide clopyralid in EP soils during the 2019 season. Eyre Peninsula Farming Systems Summary 2019 pp. 105-107. South Australian Research and Development Institute (SARDI) & Eyre Peninsula Agricultural Research Foundation (EPARF). Wudinna, SA, 5652

Seshadri, B., Surapaneni, A., Hampton, J., Short, G., Uren, P., Hetherington, C. & Currell, M. (2019) Effect of Liquid Injection of Biosolids on Groundwater and Soil Properties. CRC CARE 2019, 8th International Contaminated Site Remediation Conference incorporating the 2nd International PFAS Conference: Program and Proceedings, CleanUp 2019 Conference, Adelaide, Australia, 8-12 September 2019

Siegfried, A. (2020) The Science of Regenerative Agriculture with Dr Gwen Grelet. In Our Regenerative Future, Regenerative Agriculture. Press article published 30 April 2020. pureadvantage.org/news/2020/04/30/the-science-of-regenerative-agriculture-with-dr-gwen-grelet/

Surapaneni, A., Seshadri, B., Hampton, J., Short, G., Uren, P., Hetherington, C. & Mallavarapu, M. (2019) Soil Injection of Liquid Biosolids: Tracking the PFAS Threat in Groundwater, Soil and Forage Sorghum. CRC CARE 2019, 8th International Contaminated Site Remediation Conference incorporating the 2nd International PFAS Conference: Program and Proceedings, CleanUp 2019 Conference, Adelaide, Australia, 8-12 September 2019

Tavakkoli, E. (2020) Project Update: New products for subsoil constraints. Soil CRC Newsletter June 2020. Cooperative Research Centre for High Performance Soils, Newcastle, NSW, Australia

Yeates, K. (2020) Loving the smell of healthy soil! Soils For Life News. Soils For Life, Barton ACT 2600

Van Zwieten, L. (2020) Optimizing carbon, nitrogen and phosphorus in sandy soils. Lower Eyre Agricultural Development Association, LEADA 2020 Expo March 2020, Cummins, SA, 5631

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