Australia's leaders in the science of contamination and its remediation.

CRC CARE

A safer, cleaner environmental future

Annual Report

2014/2015

Australian Government
Department of Industry, Innovation and Science

Business Cooperative Research Centres Programme

CRC CARE is a partnership of organisations dedicated to developing new ways of dealing with and preventing contamination of soil, water and air including solid and liquid waste management. We focus Australia's foremost expertise and resources on this issue and to develop close links with research partners at the cutting edge in this field around the world.

OUR GOALS

Solutions for industry

To develop cost-effective and commercially sustainable solutions and technologies within regulatory and policy frameworks for the identification and remediation of contamination problems of key importance to Australia and the Asia-Pacific region

High quality research

To deliver research quality that positions CRC CARE as a national centre of excellence with international standing and reputation, ensuring our outcomes are recognised and utilised globally

Develop the business

To lead the development of a new export industry in environmental risk assessment and remediation through the delivery of solutions and technologies, and support their implementation with training programs that develop and improve the environmental management skills of the industry's labour force

Deliver public benefits

To ensure the effective adoption of our solutions and technologies, leading to health, environmental and economic benefits to the Australian public through reduced exposure to toxic contaminants and improved amenity of our cities as a result of cost-effective remediation/ management of urban land

Capacity building

Through university and short-term training, educate a generation of researchers and practitioners highly skilled at solving and preventing the problems of contamination, solid and liquid waste management and create employment opportunities in the industry for these specialists.

Cover image

PhD student Raghupathi Matheyarasu, whose work is supported by CRC CARE, is researching environmentally friendly techniques – including phytoremediation – for cleaning up landfill sites irrigated with abattoir wastewater.

Contents

01 EXECUTIVE SUMMARY

CHAIRMAN'S FOREWORD

For the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment (CRC CARE), the pivotal event of 2014/15 was undoubtedly our decision to re-base selected operations at the University of Newcastle, NSW. While relocating a CRC results in substantial upheaval, the Board is confident that this was the right move, providing the best possible opportunity to create an ongoing, stand-alone entity beyond 2020, when our Commonwealth funding is due to cease. The relocation was seen as essential following major restructuring at the University of South Australia (UniSA), which has seen the CRC-supported Centre for Environmental Risk Assessment and Remediation (CERAR) subsumed into a larger, less contamination-focused centre. Unfortunately this new structure diminished the chance of CRC CARE continuing after 2020 as a commercially focused centre of research excellence – a goal the CRC had been working towards over its first 10 years of operation.

Furthermore, relocation to Newcastle allows the CRC to pursue fresh scientific and commercial partnership opportunities, broaden our engagement with Australian industry and disseminate and commercialise our technological advances in risk assessment and clean-up more widely.

The CRC's Performance Review Panel concluded that this move was a sound decision, providing opportunities for the Centre to build on its established achievements to date. The move augments the number of industry and institutional partners the CRC can engage with and gives it access to the resources of the Newcastle Institute for Energy and Resources (NIER) especially, while maintaining an active research and industry program in SA, NSW, Queensland, Victoria and WA.

The financial year just passed has been difficult for staff, members of the Board and many of our researchers. The relocation of key projects and the Managing Director's office to the University of Newcastle involved difficult decisions for many people, with several staff electing to search for new roles in Adelaide.

Compounding – and partly as a result of – the disruption of relocation was the discovery by the Audit and Risk Management Chair, Bronwyn Constance, of a breakdown in the financial control function, which resulted in a loss of approximately $500,000. This loss was due to a confluence of unanticipated circumstances:

- the unbudgeted move to Newcastle
- reductions in Participant contributions – mostly delays due to hard economic times
- deficiencies in the linkage of CRC's financial and project management systems– due in part to the burden of the relocation from what became a difficult environment in Adelaide.

Immediate action by the Board and senior management included upgrading financial and project management software, scaling back non-key projects, reducing costs of administration, cancelling bonuses of senior staff and, regrettably, some staff redundancies. These measures have addressed the problem, and current forecasts show modest surpluses for the 2015/16 and 2016/17 financial years, clearly in excess of the deficit in 2014/15.

On behalf of the Board I wish to thank the University of Newcastle for its understanding and additional in-kind assistance, which includes provision of a Chief Operating Officer and Chief Financial Officer. As well as helping improve the bottom line, this assistance will greatly strengthen the management team as CRC CARE takes a new step in reach and potential influence.

Financial issues notwithstanding, the Performance Review Panel said it was impressed by the overall strong and focused management of the CRC, its unity of purpose and collaborative approach. It found the Centre has "a well-established end-user focus in the conduct and design of its research", adding, "CRC CARE is highly regarded as a source of expertise by end-users including government and practitioners. The CRC is uniquely positioned in terms of both trust and expertise to bring industry, regulators and consultants together. The Panel is satisfied that the CRC is performing to a high standard."

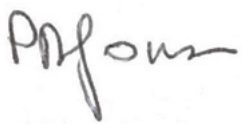
The Panel's recommendations primarily related to strategies to support the implementation of transition arrangements to maximise the legacy of the CRC and the need to explore opportunities to secure the resources and partners necessary to sustain a future beyond CRC Programme funding, which ends in 2020. The Board and management have been working on this matter for some time but clearly a stronger and more focused effort is needed. Resources available at the University of Newcastle will be vital in this endeavour.

I commend the Managing Director's Report for its account of excellent progress despite the hard times I have summarised. Particular highlights are:

- Impressive work on policy and guidance, including major steps towards a National Remediation Framework to harmonise guidance on the management of contaminated sites; the release of Australian petroleum vapour intrusion guidelines developed for Australian conditions; and dissemination of guidance protocol for the risk-based management of petroleum hydrocarbon-contaminated soils.
- With the National Measurement Institute (NMI), the CRC has developed certified reference materials for petroleum hydrocarbons. This is a world-first and will help ensure accurate and consistent testing for these important contaminants.
- Developed Australian proficiency testing to underpin accurate measurement of PFOS and PFOA, which are components of some firefighting foams (and which have been very prominent in the media lately). The CRC is also expanding its on-site PFOS/PFOA remediation work to commercial airports.

CRC CARE is a special organisation and in my view worthy of much support from the Commonwealth Government, State-based environmental agencies, companies facing serious remediation challenges, and relevant research organisations.

On behalf of the Board I would like to extend our congratulations and thanks to the management and staff of the CRC for another successful year. Despite disruption and difficulty for the CRC's fine team, it has been a year marked by significant progress in all fields of the CRC's endeavour.



Dr Peter Jonson
Chairman
CRC CARE

MANAGING DIRECTOR'S REPORT

Overview

For CRC CARE, 2014/15 was a year filled with both challenge and opportunity. Following the move to our new headquarters at Newcastle University, the CRC now operates as a virtual network of 28 research, industry and government organisations (our Participants). Our work spans the whole of Australia and we have research partnerships growing in a number of countries worldwide, including China, India, Bangladesh, South Korea, the United States (USA), the United Kingdom (UK) and several European Union nations.

Our Australian scientific partnership now encompasses the UniSA, the University of Queensland (UQ), the University of Technology Sydney (UTS), Curtin University, Southern Cross University (SCU), the Commonwealth Scientific and Industrial Research Organisation (CSIRO), RMIT University, the ChemCentre (WA) and the University of Newcastle (UON). Our overseas research partners consist of 22 universities and scientific agencies, including the universities of Lancaster (UK), Cranfield (UK), Kansas State (USA), Wageningen (Netherlands), Huazhong (China) and Tamil Nadu (India). Collectively, this scientific alliance is rapidly emerging as one of the most powerful, flexible and capable contamination and clean-up research teams in the world.

Our international reach is also being extended through the development of globalCARE™, a worldwide partnership spanning science, industry and regulators, which aims to define, measure and curb anthropogenic chemical emissions and their health impacts at the global level. Announced at the 5th International Contaminated Site Remediation Conference (CleanUp 2013), this Australian-led alliance has continued to gather momentum throughout 2014/15. See 1.4. on page 7.

1.1. Achievements

2014/15 was a big year for the CRC in successfully developing and testing new clean-up methods for air, water, industrial waste streams, petroleum and other contamination and in helping build sound policy for a healthier Australian environment. Our achievements are summarised here.

BETTER POLICY

- Strong progress in developing a National Remediation Framework, which will harmonise national guidance on the management of contaminated sites, including comprehensive consultation with industry and the broader public.
- Helped to develop an Australian policy for new and emerging contaminants under the Stockholm Convention on Persistent Organic Pollutants. This was a priority request from Australian regulators and end-users and covers six contaminants of concern. In 2014/15 the CRC worked with end users and regulators to develop scientifically-based trigger levels for intervention for these substances.
- Progress in the development of practical health and environmental guidelines for the assessment, remediation and management of the fire-fighting chemicals perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA).
- Progress in developing strategies for ameliorating and managing 'title blight' – the loss of amenity caused by contamination (and even by remediation).
- Significant scientific advances in assessing the risks to human health and the environment from contaminant mixtures.
- Created a user-friendly database for prioritised and emerging contaminants of concern.
- Data collection to support the WA Health Department health risk assessment guidelines for air contaminated by iron ore dusts in Port Hedland.
- Our acid sulfate soils project developed a new method for measuring acid neutralising capacity, which has been adopted as best management practice by regulators.
- Commenced survey into better ways to engage the community in clean-up operations.

NEW CLEAN-UP TECHNOLOGIES

- In a world-first, the CRC, with Participant NMI, has developed certified reference materials for petroleum hydrocarbons, to serve as a reliable baseline for validating the accuracy and consistency of testing for these contaminants.
- Isolated and characterised an enzyme capable of detoxifying carcinogenic benzo[a] pyrene (BaP).
- Developed a novel sensor for real-time monitoring of up to 8 different target contaminants in a single probe.
- Successful development and demonstration of a granular activated carbon (GAC) adsorption/membrane filtration hybrid system technology for removal of organic micro-pollutants from water.
- Developed a novel resin for removal of nitrates from water.
- Developed a prototype of air purifier system which uses light to cleanse indoor air of noxious pollutants.
- Developed an enhanced bioremediation method for the clean-up of highly toxic chlorinated hydrocarbons.
- With the Defence Science and Technology Organisation (DSTO), developed trigger levels to measure the fate and eco-toxicity of dinitroanisole and a novel way to biodegrade it.
- Developed and validated an *in vitro* method for assessment of BaP availability in soils.

FURTHERING GREEN REMEDIATION

- Pioneered a world-first process for green synthesis of iron nanoparticles to break down petroleum hydrocarbons and other carcinogens.
- Developed advanced guidelines for nutrient waste discharge from abattoirs.
- Identified high biomass crops to grow with abattoir wastewater irrigation.
- Developed Australian petroleum vapour intrusion guidelines which better suit Australian conditions and enable industry and regulators to refine risk assessment.
- Developed Australian proficiency testing to underpin the accuracy and comparability of PFOS/PFOA firefighting foam measurements, to achieve more reliable results, end-user confidence and improved compliance with Australian environmental policy.
- Demonstrated the potential for using industrial waste materials as filter media for removal of aluminium, molybdenum, arsenic, vanadium and gallium from alkaline drainage in constructed wetlands.
- Developed bioslurry and biopile technologies for remediation of long-term petroleum hydrocarbon contaminated soils.
- Developed new software for monitoring groundwater contamination.
- Completed investigation of arsenic bioavailability, biotransformation and detoxification/bioremediation of arsenic in water-borne organisms.
- Made important new discoveries about the role of microbes in the remediation of damaged acid-sulfate soils.
- Commenced studies of contaminant bioaccessibility in mine- and smelter-impacted soils.

WORK WITH INDUSTRY END-USERS

- With the Australian petroleum industry, developed and disseminated a guidance protocol for the risk-based management of soils contaminated long-term with petroleum hydrocarbons.
- With the Department of Defence (DoD), developed trigger levels for measuring the fate and eco-toxicity of dinitroanisole, as well as a novel way to biodegrade it.
- With DoD, developed a novel microbial system for remediating groundwater contaminated with trichloroethylene (TCE), a known carcinogen.
- With DoD, developed an innovative approach for subsurface lateral distribution of amendments, thus enhancing groundwater remediation
- Developed organoclays for remediating polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons, aqueous film-forming foam (AFFF) compounds used for fighting fires, and volatile organic compounds (VOCs), which are some of the main contaminants at DoD sites.
- Developed trigger levels for clean-up of PFOS and PFOA, requested by industry
- With HLM Asia PL, continued to develop the 'underground river' biodigester technology for processing piggery waste (pooCARE™), the use of algae for alternative energy and plant-based methods to remediate toxic waste (red mud) from aluminium processing
- Launched an industry standard for environmental consultants – Site Contamination Practitioners Australia (SCP Australia). The initiative, which is Australia's first accreditation scheme for contaminated site professionals, already has over 100 subscriptions, with 26 certified practitioners listed on its directory and endorsements from several state regulators.

CREATING A MORE KNOWLEDGEABLE WORKFORCE

- Developed training webinars, in addition to our seminar series, to reduce delivery costs and increase participation by an even wider industry end-user audience.
- With Chinese partners, including Huazhong University of Science and Technology (HUST), held our annual communication workshop in Wuhan, China.
- Established CRC CARE's Waste Demonstration Program to generate awareness of improved waste management options among industries, businesses and local governments that generate or have to deal with organic waste. Held information seminars in NT, SA and the United Arab Emirates.
- Over the year the CRC had 11 PhD, one Masters and four honours graduates. It admitted a further four PhD and three honours candidates. It continues to train 41 PhD students.
- Over 630 environmental managers from industry were trained in CRC CARE workshops.
- The CRC holds eight patents or pending patents over novel technologies in addition to four trademarks and one trade mark application.
- Most of CRC CARE's new technologies are in commercial development, with potential commercial applications being defined.
- Published more than 70 papers in peer-reviewed journals, along with one book, five book chapters, two publicly available Technical Reports and 18 conference abstracts.

PERFORMANCE REVIEW

In June 2015, the CRC Performance Review Panel reported to the Federal Government that it was impressed by the strong and focused management of the CRC, its shared unity of purpose and collaborative approach.

The Panel noted that the CRC had encountered some difficulties flowing from organisational changes at UniSA. As a consequence it had accepted an offer to relocate its headquarters to UON in NSW. The Panel concluded that "the move was a sound decision and provides alternative and additional opportunities."

The Panel's recommendations focused primarily on strategies to maximise the legacy of the CRC and secure the resources, skills and partners necessary to sustain a future beyond CRC Programme funding, which ends in 2020. These are well in hand.

INTERNATIONAL DEVELOPMENTS

Throughout the year we have continued to develop political, scientific and commercial links around the world both for the CRC and for globalCARE™, our new international clean-up alliance. Promising partnerships are emerging with India, China and the USA especially.

In other significant international developments, our collaboration with China continues, especially around pooCARE™, a technology for addressing contamination from intensive piggeries and generating bioenergy. We also hosted a chemical bioavailability workshop in China.

In the field of policy development, the CRC is working closely with European scientists on the architecture of a world-first policy incorporating bioavailability in the assessment of contaminated sites. This is expected to lead to more effective clean-up while reining in costs to industry, government and the community.

1.2. Risks and impediments

CRC CARE delivered excellent financial management during its first nine years of operation, and the 2014/15 financial year was on track to deliver another break-even if not better result. However, several unanticipated factors led to a shortfall of funds:

- Given the unexpected and fast-paced circumstances that led to the decision to relocate to Newcastle, the relocation had not been budgeted.
- The CRC experienced a temporary reduction in productivity as a result of the disruption caused by relocation, with many staff either departing the organisation or moving, with families, interstate.
- The CRC's budget forecast was overly optimistic for financial years 2014/15 and 2015/16, resulting in over-commitment and, as a consequence, a significant deficit.

Immediately upon determining the CRC's financial situation, the Board and senior management undertook a major review of the financial and project management systems. Accordingly, the CRC is now upgrading the software tool that links project management to finance.

To ensure that the CRC returns to a strong financial position, management has reviewed projects to ensure that costs match funding, implemented a series of staff redundancies, and removed bonuses for all senior staff. New 2015/16 and 2016/17 budgets have been constructed to ensure positive cash flow.

Additional financial support is being provided by UON, which is offsetting the cost of PhD fellowships approved by the Commonwealth for 2015/16, and providing in-kind contributions including the Managing Director, Finance Manager, and Business Manager's salaries.

The finance issues described here exacerbated the budget deficit flowing from a $10.8 million cut in the Commonwealth contribution while requiring the CRC to preserve all its milestones. As a result of the Commonwealth reduction, CRC CARE had already begun the process of methodically reassessing all its commitments and cutting project costs where possible. Management had also asked CRC CARE technical teams to source new income to cover the shortfall. Further, the CRC is exploring possible new end-user partnerships arising from the move to NSW, with several showing great promise.

Under the rules of CRC agreements, research equipment funded by a CRC and its partners is held at a host university. CRC CARE has over the years purchased a range of expensive leading-edge analytical equipment which was installed at the Mawson Lakes campus of UniSA. Discussions with UniSA over the ownership, location of and access to this equipment have been protracted, resulting in some disruption to ongoing research programs. This issue is raised here with a view to clarifying current CRC policy regarding the ownership and location of scientific equipment, in order to facilitate maximum research flexibility and efficiency in CRCs generally.

The move to Newcastle necessitates some staff changes, with several key officers remaining in Adelaide for family reasons. The move has also affected staff morale in some quarters. The final staff outcome of the move is not yet clear, although it seems apparent that the new headquarters will include few of the Adelaide staff and to a large extent will rely on in-kind support from UON for at least the 2015/16 financial year.

1.3. End-user environment

The clean-up sector continues to grow rapidly in Australia, having undergone a 1000 per cent expansion over the past 15 years, to a current value of around $3 billion/pa. Along with this domestic growth has been a steady expansion in exports of both knowledge and technology. The 2014/15 year saw continuing interest from large resources and manufacturing companies in seeking solutions to contamination issues as a result of widening awareness of the impact of pollutants and contaminated sites. The CRC has played a significant ongoing role in this, in the general policy environment and in bringing industry and regulators together around solutions.

While there has been some impact on industry investment in clean-up from the slowing economy, overall the clean-up sector has continued to exceed national growth rates.

The CRC's move to Newcastle opens up a much wider range of potential partners in the Sydney basin, with numerous contamination problems in need of solution. UON has been proactive in developing contacts and engagement with local NSW industry.

Last year the Commonwealth observed that the CRC appeared to be lagging in commercialisation. A key reason for our caution in this area is that that we are acutely aware of the need to avoid intruding on the turf of the commercial clean-up sector (especially given that several of our Participants reside in this sector). In 2014/15, in response, the CRC has worked closely with a range of industry consultants with a view to licensing more of our technologies and advances rather than commercialising them independently.

1.4. Impacts

As part of CRC CARE's Performance Review in 2015, we developed a revised impact tool to enable us to perform a comprehensive assessment of deliverables to assess the financial and non-financial benefits of our activities, and to identify any areas where there may be any changes in previous impact tool calculations. The revised impact tool was developed through consultation with 19 end users from DoD, the mining and petroleum industries, government, regulators, small-to-medium enterprise (SME) technology organisations, and numerous researchers. Over 30 projects were reviewed with end users having an active role in the development, testing, refinement and quantification of impacts and the basis for their quantification. Assumptions were often drawn from demonstrated impacts evident at end-user pilot projects. This approach: (a) offers an objective revision and assessment of the estimated impacts; (b) highlights changes in probabilities, risks and impact milestones; and (c) identifies additional impacts not cited in the original impact tool. The revised impact tool provides a mix of actual (up to 30 June 2014) and forecast impacts (up to 30 June 2026).

Additional impacts, or impacts for which we have exceeded original estimates, include the following:

- The adoption of the health screening levels (HSLs) into the National Environment Protection (Assessment of Site Contamination) Measure ('the NEPM') is estimated to have created contaminated site assessment savings in the order of tens of millions of dollars per year. In its impact statement for the variation to the NEPM, the National Environment Protection Council stated: "The adoption of [CRC CARE] HSLs is expected to deliver significant cost benefits to assessment and development of affected sites."
- Above estimated savings to end-users (BHP Billiton Iron ore and DoD) from the use of new innovative remediation technologies developed (Program 4).
- Additional impacts from research projects associated with the development of sensitive analytical techniques for emerging and priority contaminants, such as the development of assays for *in vitro* toxicity testing, and improved measurement reliability for key perfluorinated compounds PFOS and PFOA (Program 2).
- Additional impacts related to the employment and training of 36 PhDs, 33 postgraduate completions and 2500 industry environmental managers.

In some areas, CRC CARE exceeded the original expectations, particularly in relation to education, training and communication. Highlights here include: the development of SCP Australia; online access to more than 30 technical reports from CRC CARE I and II; development of evidence-based novel remediation technologies; and the adoption into the NEPM of HSLs for hydrocarbons and standard operating procedure for heavy metal(loid)s bioavailability. More broadly, CRC CARE has exceeded expectations in the way it has established a critical mass of research, industry, regulatory and practitioner expertise, and thereby fostering a scientifically rigorous, innovative and progressive sector that better manages the environmental impacts of their operations.

The revised impact tool also sees an increase in the overall cost-benefit ratio to 5.98 (based upon conservative impact estimates by end users) from the original estimate of 4.95. Based on the revision, CRC CARE will contribute $2.7 billion dollars of direct economic impact – more than four times the original predicted impacts. This represents a 15-fold return on inputs and also includes significant non-financial benefits associated with reduced risk to human health and the environment and improved environmental practices. Furthermore, the assessment takes into account that CRC CARE's development of new technologies allows the remediation and subsequent reuse of contaminated land and water that could not previously be remediated economically under conventional approaches.

The detailed changes and their rationale are presented in the *CRC CARE: Performance review impact indicator tool companion document*, which was prepared for the CRC's Performance Review in May 2015. It is available as a downloadable PDF at www.crccare.com/publications/crc-care-s-impact-tool

1.5. Concluding remarks

The list of achievements for 2014/15 above makes it clear that CRC CARE is performing very strongly in developing new science, technologies, policy, end-user partnerships and in training. Our chief challenges are to overcome the existing budget deficit and to re-settle those parts of the research program and staff affected by the move.

The CRC continues to mature its plans to develop a self-sustaining research partnership in contamination science beyond 2020, when CRC Programme funding ends.

In conclusion, I wish to express my sincere appreciation and admiration of the quality of work by our dedicated and enthusiastic staff, the wise guidance of our Board and the continued strong support and encouragement we receive from all our partners in industry, science and government.

Professor Ravi Naidu
Managing Director
CRC CARE

02 RESEARCH

2.1. Performance against activities

CRC CARE is an independent organisation that performs research, develops technologies and provides policy guidance for assessing, cleaning up and preventing contamination of soil, water and air. Environmental contamination is a major threat to the health of our communities, the environment and our economies. Australia alone is estimated to have more than 160,000 potentially contaminated sites, with an estimated five million worldwide.

The CRC works with organisations that deal with contamination – including the mining and petroleum industries, state environmental regulators, government agencies, and environmental consultants – to create industry-ready solutions to real-world problems. By collaborating with leading environmental research groups around the world, CRC CARE remains at the forefront of international scientific developments in the field of environmental contamination and remediation.

Established under the Australian Government's Cooperative Research Centre (CRC) Programme in 2005, CRC CARE represents Australia's foremost expertise in the development, utilisation and extension of advanced technologies and methods for:

- assessing contamination risks in land, groundwater and air
- managing and remediating contamination
- developing safe options for land use and the reuse of wastes on land
- developing solutions that are acceptable to regulatory agencies and the public
- capacity building.

Originally funded for a seven-year term, in 2010 CRC CARE applied for and received an additional nine years of funding through the CRC Programme. Having commenced on 1 July 2011, CRC CARE's second term will continue through to 30 June 2020.

This annual report details the activities of CRC CARE from 1 July 2014 to 30 June 2015.

PROGRESS AGAINST THE KEY CHALLENGES/ OUTCOMES

The 2014/15 financial year was the fourth of CRC CARE's second term, which sees it supported through to 2020. The CRC's four main research programs build upon and extend the work done in the six years of the Centre's first term. A fifth 'program' covers 17 projects that continued beyond the CRC's first term – four of which were ongoing in 2014/15.

Together, the 2014/15 research programs comprise 27 research milestones and 4 utilisation milestones for the reporting period. Overall, 22 (81%) of the research milestones and 3 of the utilisation milestones were completed. The CRC's relocation to Newcastle, and the attendant disruption, was a major reason for the lower-than-usual completion rate.

Research milestones

PROGRAM	MILESTONES COMPLETED	COMMENTS
1	2 of 5	Three milestones uncompleted as a result of work commencing later than planned. Work is well under way in all three, with two expected to be complete in late 2015, and the third commencing in August 2015.
2	8 of 10	One milestone was uncompleted due to change in priority by end users, who initially identified the milestone during the bid development process. The second milestone was delayed due to the lack of an adequate project proposal and late commencement.
3	6 of 6	All complete.
4	6 of 6	All complete.

Utilisation milestones

The one uncompleted utilisation milestone, from Program 3, was delayed because a literature search demonstrated the need for multiple sub-risk assessment models that would contribute to the risk and compliance model. While a vapour intrusion model has been developed, work on a model incorporating bioavailability requires a lot more research than previously anticipated. An additional milestone, pinned to the development of a plan for the CRC's transition after Commonwealth funding ends, was completed.

CRC CARE'S RESEARCH

In addition to its four research programs, CRC CARE manages a National Contaminated Sites Demonstration Program (NCSDP), which takes research from the lab to demonstration sites in the field. The research programs are augmented by the CRC's China Program, which focuses on environmental remediation research. Although the NCSDP and China Program fall under the four main research programs, they are managed separately by their own program coordinators, and are reported separately in sections 2.1.6 and 2.1.7.

The NCSDP continues to operate in CRC CARE's second term with the support of the Australian Institute of Petroleum (AIP), DoD, BHP Billiton Iron Ore (BHPBIO) and HLM Asia Group Ltd.

CRC CARE is now four years into its second term, which has an increased focus on harmonising policies and guidance on environmental contaminants. The CRC's work on a National Remediation Framework is a major initiative to this end. Crucially, CRC CARE consults both regulators and industry on its policy work, thus ensuring buy-in from two key groups that, historically, have at times been at odds. This consultative approach increases the likelihood that, once they are developed, policies and guidelines are adopted.

As the CRC moves closer to the end of its current (and second) term of Commonwealth funding, it is also developing plans to increase both its public good utilisation and its commercial focus, which will form the basis for CRC CARE's continuation beyond 2020.

CRC CARE's four research programs are:

- Program 1: Best Practice Policy
- Program 2: Better Measurement
- Program 3: Minimising Uncertainty In Risk Assessment
- Program 4: Cleaning Up.

2.1.1. PROGRAM 1: BEST PRACTICE POLICY

Program Leader:
Dr Bruce Kennedy, CRC CARE

CRC CARE's Best Practice Policy program develops the principles, indicators and strategies to support the development of policy, as well as a national guidance framework, for environmental remediation. This involves assessing the benefits of remediation, the impacts of current remediation practices, the risks and the uncertainties. This program is also developing guidance for the assessment and management of emerging and priority contaminants.

A greater understanding of the social and economic aspects of remediation will enable remediation guidance to move beyond technological issues.

Program 1 combines environmental economics, sustainability science, property rights theory, and social science to focus on:

- how contamination affects the value of contaminated sites and their surrounding property, and public perceptions of 'title blight'
- incentives for industry, developers and government to assess and reclaim contaminated sites, including formal offset schemes, public perception and corporate responsibility outcomes.

This program is also developing strategies and instruments to engage effectively and positively with communities to take into account their perceptions of remediation technologies. This is essential to improving the economic and environmental sustainability of remediation.

The program's key research areas are:

- guidance for emergent and priority contaminants
- use of flux-based criteria for the management of groundwater contamination
- a national guidance framework for remediation in Australia
- classification and ranking of incentives for remediation and for the reduction of title blight
- innovative decision-making strategies for selecting remediation technologies based on effective community engagement.

Program 1 highlights for the 2013/14 financial year are summarised here.

GUIDANCE FOR EMERGENT AND PRIORITY CONTAMINANTS

CRC CARE has made significant progress in the development of practical guidance for the assessment, remediation and management of perfluorinated chemicals, BaP and methyl *tert*-butyl ether. This advice is expected to be available in early 2016.

The guidance will include health and ecological screening criteria for PFOS and PFOA, historically used in firefighting foams. This legacy contamination is of particular concern to the Australian community.

CRC CARE is also carrying out preliminary work for the development of guidance for additional contaminants such as weathered hydrocarbons.

Key issues: the challenge is to develop effective guidance in a reasonable timeframe, taking into account uncertainties.

FLUX-BASED CRITERIA FOR REMEDIATION

A review of the use of flux-based criteria in Australia and internationally for land and groundwater remediation, particularly from petroleum contamination, was completed in 2014. Significant progress has been made on the development of guidance to assist in decision-making by regulators and industry. It is expected that the criteria for acceptable levels of contaminant flux (the rate of movement of contaminants through groundwater) will provide a complementary tool to the concentration-based criteria that are currently in use. The development of flux guidance is expected to be completed in 2015.

Key issues: flux-based criteria for decisions on remediating and managing groundwater contaminant plumes are currently used in very few jurisdictions around the world, making this approach potentially world best practice when used in conjunction with the current concentration-based criteria.

NATIONAL GUIDANCE FRAMEWORK FOR REMEDIATION

CRC CARE is developing a nationally harmonised remediation framework to complement the NEPM. At present the NEPM provides nationally harmonised guidance for the assessment, but not remediation, of site contamination. The development of the remediation framework will utilise existing guidance, expertise and hard-won experience, and will incorporate practical guidance for both remediation and long-term management of remediated sites. A National Remediation Framework Steering Group, comprising senior representatives from industry and government, provides strategic oversight for the development of the framework.

Overall, the remediation framework aims to:

- achieve greater certainty in environmental outcomes
- facilitate consistency in decision making
- maintain decision-making flexibility at state and local levels
- not intrude on the prerogatives of state and territory policy making and implementation
- promote consistent implementation of guidance
- promote training and accreditation of personnel
- minimise costs to industry and society.

A consultation strategy for garnering stakeholder/public feedback was developed, and consultation began in June 2014. Prior to this, heads of Environment Protection Authorities (EPAs) and industry representatives received information packages on the framework. The CRC CARE website was used to distribute consultation documents and to provide information on processes, feedback mechanisms and timeframes.

The Framework comprises practical guidance modules and Program 1 is well on track to complete all draft guidelines for consultation by the end of 2015.

Key issue: CRC CARE will work through the 'Heads of EPAs' forum, as well as through jurisdictional representatives on the National Remediation Framework Steering Group, in order to assure adoption and endorsement of the Framework by governments.

INCENTIVES FOR REMEDIATION AND REDUCTION OF TITLE BLIGHT

Contaminated sites, and even remediated sites, may cause loss of local amenity and environmental values as well as reducing property prices (so-called 'title blight'). Identifying the barriers to remediation and redevelopment, as well as the extent of the impact of these barriers, will create a significant knowledge base from which to develop intervention measures.

CRC CARE awarded a PhD scholarship to Ms Kerry Scott, at UniSA, to undertake research on title blight issues, and meet relevant milestones in the Commonwealth Agreement. During 2014/15 the research design and methodology were drafted and survey instruments were developed. The survey work will commence in late 2015.

Key issue: the longer-term challenge is to ensure the development of practical strategies for the amelioration and management of title blight.

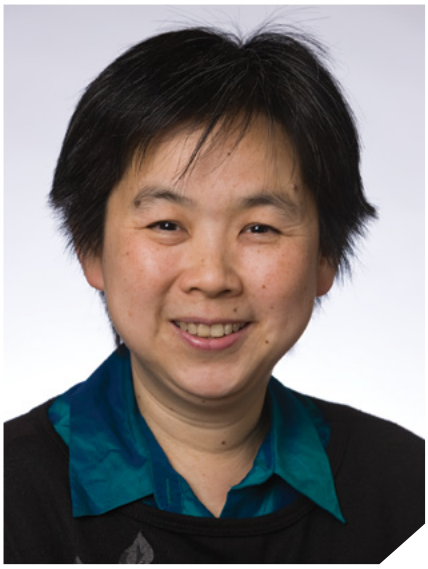
COMMUNITY ENGAGEMENT

Community engagement – not just consultation – is important as society becomes more aware of the impacts of remediation activities. A well-structured engagement strategy is expected to lead to positive outcomes in the selection of remediation technologies. CRC CARE, with UTS, is undertaking an extensive project titled 'Societal perceptions and acceptability of remediation technologies', which will address the milestones for this output.

Background studies and research methodology strategies have been completed. Survey work was completed in late 2014 and analysis of the results reported in the first half of 2015. The results will guide the development of a draft communication strategy to facilitate the engagement of affected community members and in the selection of appropriate remediation methods and technologies.

Key issue: the longer-term challenge is to ensure the development of practical strategies for effective community engagement.

2.1.2. PROGRAM 2: BETTER MEASUREMENT



Program Leader:
Dr Cheryl Lim, National Measurement Institute

A major challenge facing the remediation industry is to identify, measure and delineate contamination with sufficient certainty to make good decisions about clean-up within budget. Current measurement methodologies and technologies have many limitations that lead to uncertainty, time and cost in the site assessment process.

The most critical of these are:

- the lack of methods and technologies to accurately measure and characterise complex and ill-defined mixtures of compounds, such as naturally degraded materials (e.g. weathered hydrocarbons and weathered asbestos) and emerging contaminants (e.g. perfluorinated compounds, pharmaceuticals).
- the inability to measure and characterise contamination that extends across different media (e.g. soil, air, water, biota)
- the inability of many methods and technologies to accurately detect and measure at the concentrations required by accurate risk assessment methods
- the lack of suitable quality assurance tools to ensure comparability and reliability of results produced by these methods
- the inability to conduct rapid real-time, in-field analysis that is sufficiently sensitive to depth profile, matrix inhomogeneity and other effects
- the inability to account for environmental variability and inhomogeneity when extrapolating from point-based field measurements or using field samples to average over the site under investigation.

CRC CARE's Better Measurement program is developing the next-generation analytical methods and innovative field technologies to provide fast, efficient assessment of site contamination. A major aim is to replicate laboratory outcomes in the field using newly developed real-time monitoring tools.

The program integrates advanced on-site and on-line measurement methods with conventional sampling and analysis to develop reliable real-time predictive and diagnostic tools. To ensure the remote capability and greater efficiency of these tools in the field, web-enabled recording and reporting of data are also being developed.

The Program works with end users, including site assessors and remediators, to develop the tools they most need to measure and characterise environmental contaminants with sufficient certainty to make decisions which optimise the remediation strategy.

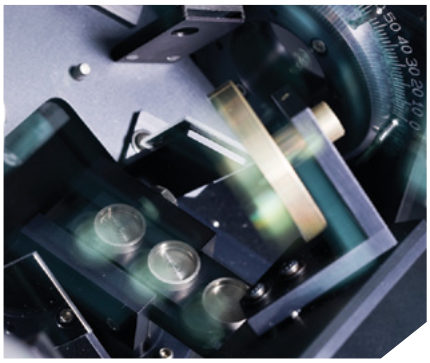
Key research areas are:

- sensitive analytical techniques for emerging and priority contaminants
- novel assessment and remote online monitoring systems
- integrated information management tools
- standards for sampling contaminated material.

PROGRAM HIGHLIGHTS

Highlights from Program 2 are summarised here.

- NMI and EPA Victoria have collaborated with CRC CARE to develop and undertake Australia's first proficiency study for PFOS and PFOA in environmental matrices. The performance of 11 participating laboratories was compared using a set of two soil and two water samples. PFOS and PFOA are common synthetic fluorinated chemicals that have been identified as health and environment concerns due to their known toxicity and resistance to degradation; both chemicals are regulated by the Stockholm Convention for Persistent Organic Pollutants. The development of Australian proficiency testing capabilities will help ensure the quality and comparability of PFOS/PFOA measurements, increase end-user confidence in overall data quality and the reliability of results, support Australian environmental policy, and may identify factors which can then be addressed by laboratories to improve their PFOS/PFOA analysis methods. This work has generated a great deal of interest within Australia and overseas, including a request from the Australasian Land & Groundwater Association (ALGA) for presentations on this project at recent ALGA Forums.
- As part of a project to develop superior ion selective electrode technology for field measurement of contaminants, two patents have been drafted and filed by CRC CARE, based on work done by researchers based at UniSA.
- In a research project at UQ into the improvement of pathway-based bioassays for predicting toxicity of environmental contaminants, researchers investigated a variety of potential reference compounds to assess the degree to which selected cell lines can be used to measure environmental pollutants, and tested refinements to the design of their construct to enhance response. The fundamental research conducted has produced some highly relevant results on cellular defence mechanisms, and will lead to a high-quality PhD thesis. The results also provide new tools for mechanism-based risk assessment. Furthermore, stably transfected cell lines with the gene constructs have been produced, a crucial step in developing an easy-to-use assay with potential commercial value.

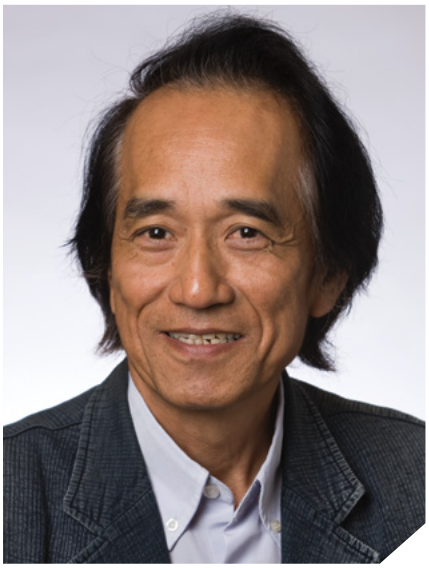


- NMI compared the four extraction methods specified in the NEPM for total recoverable hydrocarbon, a key measure of petroleum hydrocarbon-related contamination. Six different materials typical of common environmental matrices were tested, including NMIA MX015, a Certified Reference Material prepared by NMI from contaminated soil in an earlier stage of the same project. This work also investigated the differences in results arising from use of the alternative extraction solvents specified in the USEPA method documents referenced in the NEPM.
- To address end-user requests for more training and knowledge dissemination related to sampling, the leaders of the CRC's Measurement and Education Programs have brought together a selection of national and international speakers for the CleanUp 2015 conference (held in September 2015) to present the results of international research relating to field sampling developments.
- Program 2 has yielded a number of publications in international peer-reviewed journals, including *Toxicological Sciences*, *Sensors and Actuators B*, and *Chemmometrics and Intelligent Laboratory Systems*. An Honours thesis has also been submitted based on work in this program.

KEY ISSUES CONFRONTING THE RESEARCH

Measurement reliability and accuracy is often taken for granted, yet it is critical to the implementation of environmental policy and regulation, and the effectiveness of risk assessment and remediation. The development of novel fit-for-purpose techniques for lab-based and field measurement is an ongoing challenge, with a growing number of emerging and priority contaminants to be addressed, such as the newer perfluorinated compounds, novel flame retardants and short-chain chlorinated paraffins.

2.1.3. PROGRAM 3: MINIMISING UNCERTAINTY IN RISK ASSESSMENT



Program Leader:
Professor Jack Ng, University of Queensland

Health risk assessment has its origins in toxicology (the study of poisons): the classical statement that "the dose makes the poison" remains true today. However, contemporary environmental and health risk assessment required by regulators, industry and health agencies demands a more refined, evidence-based approach. Risk assessment based on total contaminant concentration is becoming outdated due to the high degree of uncertainty, and this may lead to unnecessarily stringent and costly remediation.

Program 3 aims to improve the certainty of risk assessment by considering:

- the fate of chemical compounds in the environment
- the bioavailability of contaminants, to achieve a more refined exposure assessment
- the influence of weathering, ageing and soil properties.

It also focuses on the risk characterisation and assessment of contaminant mixtures, with particular reference to matrix properties, mixture interactions and their effects on bioavailability leading to adverse health effects.

Program 3 outcomes are designed to help regulators, industry and environmental consultants and risk assessors to make informed decisions with reduced uncertainty, and thus better protect human and ecological health at sites which have complex mixtures of contaminants. The program focuses on:

- the fate of chemicals in the main Australian soil types
- quantifying toxicity and bioavailability of individual and mixed contaminants
- quantifying pathways of exposure and transient risks
- creating databases for prioritised and emerging contaminants
- developing a robust risk and compliance model.

Its main aim is to develop new technology, methods and knowledge that will minimise uncertainties in assessing health and environmental risks. Through national, international and in-house collaborations it will contribute to creating the next generation of HSLs and risk assessment approaches.

PROGRAM HIGHLIGHTS

Previous bioavailability/bioaccessibility guidance and HSLs have already generated multi-million dollar economic returns in the assessment and remediation of site contamination as measured by the Impact Tool. Future HSLs, risk assessment guidance documents and tool kits will deliver similar benefits to the end-user.

An example is our production of the Australian Petroleum Vapour Intrusion Guidance, which is attuned to Australian conditions and enables consultants and regulators to refine their risk assessments. This new knowledge has been delivered to industry through CRC CARE national road shows and webinars.

Highlights and achievements for 2014/15 are summarised here.

- Assessing the risk to human health and the environment from mixed contamination. This project has made significant advances in the interaction, bioavailability and toxicity of mixed organic (PAHs) and inorganic contaminants (metals and metalloids). The project will feed data into Project 4 and has potential policy implications for assessing mixed chemicals on contaminated sites (e.g. for future NEPM reviews). New findings were presented by Prof. Ng to members of the Australian Contaminated Land Consultants Association (ACLCA) and an update on this work via our CRC CARE Webinar series as part of the continuing Education and Training Program. The project is a collaboration between UniSA and UQ.
- Environmental risk assessment of nanomaterials for soil and groundwater remediation. Project 2 focuses on zero-valency iron nanoparticles for cleaning up polluted groundwater. The project is near completion and its outcome has potential applications for soil and groundwater remediation. High quality papers have been published with one PhD awarded to date. The project is a collaborative effort from UniSA and UTS.
- Arsenic bioavailability, biotransformation, and detoxification/bioremediation of arsenic using in aquatic organisms. This project is near completion with almost all the results published. The project has generated knowledge from a mechanistic viewpoint of the toxicity of arsenic to aquatic organisms. It also investigated the potential for using aquatic organisms for the remediation of arsenic in the water. The project is a collaboration between UniSA and UTS.
- Risk compliance modelling. This project models the uncertainties associated with various components within the enHealth/USEPA health risk assessment framework, and refines important parameters to minimise them. A conceptual framework for risk compliance modelling has been developed with the risk modeller awaiting information on existing human health risk assessment models from consulting companies. The project advisory group includes regulators, an international expert, scientists and the program leader. Key outcomes delivered thus far demonstrate widely different fates and behaviour of both metal and organic contaminants in soils varying in physicochemical and mineralogical properties. As a consequence, the bioavailability of both inorganic and organic contaminants varies considerably. This has implications for human exposure to contaminants, the risk these contaminants pose, and potential remedial actions. A number of scientific papers are in review.
- Mineralogical constraints associated with contaminant bioaccessibility in mine- and smelter-impacted soils. The start of this project was delayed by the difficulty in recruiting a PhD student: a suitable candidate was appointed at UniSA in 2014. The research has since generated a significant volume of data.
- Data collection to support Port Hedland health risk assessment guidelines. A collaboration between ChemCentre, WA DER and the WA Department of Health, this is a follow-up project from CRC CARE's first term (Inhalable iron-ore dust). Vast quantities of dust/air quality data (particularly PM10 particulates) were collected and studied for physicochemical properties. The data have been integrated into a health risk assessment. This work is highly relevant to the iron-ore industry in WA, which is worth tens of billions of dollars per year.
- Create database for prioritised and emerging contaminants. The US Agency for Toxic Substances and Diseases Registry publishes a long list of prioritised hazardous substances including emerging compounds of concern. This is based on concern over their known or potential toxicity to the environment, animals and humans. Australia lacks a user friendly centralised database to help risk assessors and regulators obtain critical data/information for conducting risk assessment. The database we are building will include physical and chemical parameters including speciation and fate of target compounds in the environment and biota, toxicity profiles and bioavailability data in a one-keyword searchable format. It will also identify data gaps for which directed research projects, that are relevant to Australian conditions, can be developed. A web-based database or stand-alone package will be the product of this project. In 2014/15 we constructed a searchable prototype of the database. The project is coordinated via UQ.

STAFF HIGHLIGHTS

- Prof. Ravi Naidu was a co-editor of the International Arsenic Congress book series in 2014 and presented a keynote address at the 10th SETAC Europe Special Science Symposium in Belgium in October 2014 on *Remediating soils: Bioavailability as a tool in site management*.
- Prof. Jack Ng was recertified as a toxicologist with the American Board of Toxicology.
- Prof. Ng was an invited keynote speaker and session chair at the BIT's 4th Annual International Congress of Environment – 2014, 21-23 September 2014, Qingdao, China.
- PhD student Sasikumar Muthusamy was elected a committee member of the Australasian College of Toxicology and Risk Assessment (ACTRA) at its 2014 annual general meeting (AGM).

KEY ISSUES CONFRONTING THE RESEARCH

It is impossible to conduct thorough studies on every one of the huge number of chemicals (contaminants) in the environment. Through a consultation process involving CRC CARE researchers and partners together with industry and regulators, a shorter list of priority contaminants was generated and our research projects are now targeting this short list of contaminants only.

The recent move of the CRC CARE to the University of Newcastle has affected progress for some scientists and students who decided to move from UniSA. However, the program's overall deliverables are on track over the life of the CRC to 2020.

AWARDS/RECOGNITION

- Dr Erica Donner has been awarded an ARC Future Fellowship.
- Prof. Ng:
  - continues to serve as a World Health Organization advisor
  - is on the assessment panel for registered member and fellowship of ACTRA
  - was appointed a local chair to organise the ACTRA Annual Scientific Meeting in Brisbane in 2015
  - is one of three appointed editors for the 3rd edition of *Elements and their Compounds in the Environment* published by Wiley-VCH (2013-2016).

2.1.4. PROGRAM 4: CLEANING UP

Program Leader:
Professor Megharaj Mallavarapu, UniSA

This program aims to develop, evaluate and demonstrate the technologies, indicators and strategies for *in situ* management of contamination issues experienced by industries and the community. It addresses the limitations of existing assessment and remediation technologies for effective reduction of risks to human and environmental health, as well as developing sustainable and 'green' remediation technologies. This green approach seeks to exploit the unique properties of biological material (e.g. plants or microorganisms) rather than potentially dangerous synthetic chemicals that may pose a subsequent risk to people or the environment. The Program also establishes the parameters for effective risk reduction in unique Australian soils and aquifers. It is the engine room for technologies scaled up and demonstrated in the field as part of the DoD and Petroleum Demonstration Programs.

Key research areas are:

- novel remediation technologies for emerging and priority contaminants
- development, testing and validation of sustainable and green technologies.

Currently, this program has 14 projects:

- Green synthesis of iron nanoparticles and their application as a Fenton-like catalyst for the degradation of total petroleum hydrocarbons (TPH) in ground water and oil sludge
- Road-deposited sediment pollutants, mobility and bioavailability remediation
- Novel solar driven fibreoptic photocatalysis hybrid system for groundwater treatment
- Heavy metal, metalloids remediation from drinking water by innovative adsorbents
- Biosensor and enzymatic remediation approaches for carcinogenic BaP
- High quality water reuse through the development of a membrane hybrid system for removal of persistent organic pollutants, including pharmaceuticals and personal care products
- Development of a sustainable groundwater treatment system for nitrate removal using novel surface modified adsorbents.
- Development of nanoparticles and molecular imprinted polymers – immobilised electrospun polymeric nanofibrous mats for environmental remediation
- Prominent Hill mine tailings evaluation
- Nutrient management from wastewater discharged from abattoir
- Development of new green and sustainable remediation technologies
- Natural clay mineral–graphene composites for sustainable remediation
- A novel technology for extraction of iron from red mud
- A novel framework to identify, predict and improve the efficiency of bioremediation.

ACHIEVEMENTS

The program's main achievements in 2014/15 included:

- Isolation and characterisation of an enzyme capable of detoxifying carcinogenic B[a]P, a polyaromatic hydrocarbon (research performed at UniSA)
- Successful green synthesis (using a plant and algal extract) of nanoparticles for remediation of petroleum hydrocarbons and toxic hexavalent chromium (UniSA)
- Identification of high biomass crops to grow under abattoir wastewater irrigation and reduce nitrous oxide (N2O) emissions (UniSA)
- Successful development and demonstration of a GAC adsorption/membrane filtration hybrid system technology for removal of organic micro-pollutants from water (UTS)
- Developed a novel adsorbent (grafted anion exchange resin) for the removal of nitrate from water (UTS)
- Successful synthesis and demonstration of various magnetic core/shell-structured catalysts for selective production of reactive radicals for wastewater treatment (Curtin University)
- Development of a prototype of air purifier system with superior photocatalysts (Curtin University)
- Demonstration of alum water treatment sludge as a feedstock for compost substantially reduced CO2 emissions besides immobilising heavy metals and phosphorus (P) during composting (UQ)

Program 4 also had considerable success in field application of several new or improved technologies via CRC CARE's NCSDP:

- CRC-supported researchers at Curtin University have designed a pilot plant for the removal of volatile contaminants in indoor air; this unit is now set to be trialled in a sample of dwellings.
- Demonstrated bioslurry and biopile technologies for remediation of long-term petroleum hydrocarbon-contaminated soils (see *Petroleum Program* on page 16).

- CRC CARE's risk-based remediation approach was demonstrated successfully for long-term petroleum hydrocarbon-contaminated soils, generating substantial savings for BHPBIO (also see *Petroleum Program*).
- matCARE™ technology has been extended to remediate AFFF-contaminated wastewater at airports (Airservices Australia).

KEY ISSUES CONFRONTING THE RESEARCH

Recently, several new chemicals (e.g. perfluorochemicals, or PFCs) have been designated 'contaminants of emerging concern'. Developing next-generation sustainable remediation technologies for contaminants of emerging concern is a challenge and requires novel approaches and considerable funding. Although biotechnological solutions are often the most effective way to sustainably manage contaminants, they require considerable time and investment. Adequate support will be required to position Australia at the forefront of remediation research globally and safeguard the nation's health and environmental future.

AWARDS/RECOGNITION

- Prof.Ravi Naidu:
  - Presented a keynote talk on *Soil contamination impact on human health* at the Contaminated Land, Ecological Assessment and Remediation conference (CLEAR 2014), in Korea in October 2014
  - Was invited by the World Trade Organization to present on *Environmental remediation and clean up*
  - Presented a keynote talk at the Royal Australian Chemical Institute National Congress in Adelaide in December 2014 on *Recent advances in contaminated sites remediation: green and nano-remediation technologies*
  - Presented a keynote talk on *Remediation options for aqueous and solid phase AFFF clean up* at Ecoforum in the Gold Coast in October 2014
  - Was appointed Co-Editor-in-Chief of a new Elsevier journal, *Environmental Technology & Innovation.*
- Prof.Richard Haynes appointed Editor-in-Chief of the *International Journal of Environmental Science and Development*.
- Prof.Haynes delivered keynotes on:
  - Sustainable vegetation at 10th International Alumina Quality Workshop, Post Conference Workshop: *Maintaining a flexible approach to closure and rehabilitation of residue storage areas*
  - *Sustainable technologies for storage, management and revegetation of mine tailings* at the 4th International Conference on Environment, Science and Biotechnology, Phuket, Thailand, in December 2014
  - *Use of constructed wetlands as a technology for reducing energy requirements for wastewater treatment* at 4th International Conference on Future Environment and Energy, Melbourne, Australia, in January 2015.
- Dr Thomas Jeffries (University of Western Sydney) won an Early Career Research grant ($20K).

2.1.5. PROGRAM 5: CONTINUING PROJECTS

Program Leader:

Professor Nanthi Bolan, UniSA

Program 5 comprises 17 research projects that began in CRC CARE's first term of funding and carried through to the second term. These projects cover the CRC's four original programs: Risk Assessment; Remediation Technologies; Prevention Technologies; and Social, Legal, Policy and Economic Issues.

At the end of the reporting period, two projects remained in Program 5. These are expected to be completed by December 2016. The completed projects achieved all of their research and utilisation milestones, succeeded in developing novel technologies, produced more than 20 papers in peer-reviewed journals, and engaged successful PhD students. CRC CARE is pursuing the field adaptation of some these technologies (e.g. phytocapping) with its industrial partners and other commercial organisations.

Highlights of 2014/15 are summarised here.

BIOSOLIDS PROJECT

This project aims to develop guidelines for the safe re-use of biosolids from sewage and other waste disposal systems. The end-users of the results of this project are environmental regulators, the water industry and the agricultural sector. The project has demonstrated that:

- the quality of biosolids in Australia has increased substantially over time
- the speciation of metals in biosolids indicate that some metals, such as copper, which partition strongly to the organic fraction of biosolids should be the focus of continuing scrutiny
- particular care should be given to situations where biosolids are applied to soils of neutral pH with a low cation exchange capacity (CEC), as in these cases the bioavailability of metals depends very much on biosolid characteristics.

The relevance to the water industry relates to a better understanding of metal(loid) chemistry during the anaerobic digestion phase and the importance of post processing. In addition, the results suggest that the implementation of wastewater strategies involving the use of chemical agents (i.e. containing iron and aluminium) would have little impact on metal bioavailability. These strategies, which have at times attracted attention, do not seem to be viable.

The results of this project are of relevance to the agricultural community in relation to the specific soil situation where addition of biosolid, which is generally seen as beneficial, should be considered with care. In specific, sandy soils with neutral pH and low CEC are particularly vulnerable.

BIOSENSOR PROJECT

This project is designing a world-first biosensor for use in heavy metal detection. Its potential end users are companies involved in assessing, cleaning up and monitoring contaminated sites.

We have developed the use of Emerald Green Fluorescence Protein (EmGFP) in *Bacillus megaterium* as part of a novel whole-cell biosensor for detecting heavy metal contamination. The biosensor developed can be used in environmental monitoring where a versatile general biosensor is required to measure the bioavailable fraction of metals of concern in soil.

PHYTOCAPPING PROJECT

This project aims to design a 'green' method for capping waste dumps that will both reduce their environmental impact and create a local source of clean energy.

The end-users of this project are landfill regulators, regional and city councils and waste industries. The project has demonstrated that:

- high biomass producing plant species such as giant reed and Napier grass can be used to revegetate landfill sites as a phytocap to replace the normal clay capping
- phytocapping decreased landfill leachate by more than 80%, thereby mitigating environmental degradation and offsite impacts from landfill sites
- these plant species provide a valuable source of biomass for energy production through anaerobic digestion.

The outcomes of this project are applicable to degraded land sites including mine sites, landfills and waste dumps both in Australia and around the world.

AWARDS/RECOGNITION

- Associate Prof. Bithin Datta was invited to edit a special issue on 'Optimization for groundwater characterization and management' for *Hydrogeology Journal*.
- Prof.Nanthi Bolan was:
  - Awarded an American Agronomy Society Fellowship
  - Guest editor of special issues on 'Soil: Source and Sink for Greenhouse gas emission' for Science of the Total Environment.
  - Keynote speaker – 2nd International Contaminated Land, Ecological Assessment and Remediation conference (CLEAR 2014), Chuncheon, Korea
  - Keynote speaker – 2014 Taipei International Conference on Remediation and Management of Soil and Groundwater Contaminated Sites, Taipei city, Taiwan.
- Post-graduate students working on CRC CARE projects received the following awards:
  - University President Honours Award 2014 – Ms Sanchita Mandel (UniSA)
  - Best young career researcher award 2014 – Dr Antiha Kunnuikrishnan (UniSA)
  - CRC CARE Communicate 2014 best 3-minute PhD thesis presentation award – Ms Ramya Thangarajan (pictured below with Managing Director Prof. Ravi Naidu).

2.1.6. NATIONAL CONTAMINATED SITES DEMONSTRATION PROGRAM

2.1.6.1. Petroleum Program

Program Coordinator:
Dr Prashant Srivastava, CRC CARE

AUSTRALIAN INSTITUTE OF PETROLEUM

AIP represents major oil refining and marketing companies in Australia. The industry, through AIP, joined CRC CARE in 2005 and the AIP demonstration program was initiated to address policy issues related to contaminated site assessment.

The major focus of AIP Program now is on petroleum light non-aqueous phase liquid (LNAPL) contamination of sub-surface soils. A major project to determine the end-point for LNAPL remediation is under way. This aims to identify the underlying factors and processes that control LNAPL remediation and to determine the practicability of potential end points of LNAPL remediation in a range of settings. The outcome of the project will help the stakeholders determine when clean-up has attained its purpose and when to stop remediating LNAPL in the subsurface.

This year, CRC CARE released a succinct, user-friendly practical guide on LNAPL assessment, remediation and management. *CRC CARE Technical Report 34: A practitioner's guide for the analysis, management and remediation of LNAPL* is available as a hardcopy to purchase and as a PDF for free download via CRC CARE's website. To extend the results to industry around Australia, the CRC held a series of workshops on LNAPL assessment, management and remediation in the five major capital cities in 2014/15. These workshops were well attended, with positive feedback from attendees.

BHP BILLITON IRON ORE

In 2008, CRC CARE initiated a demonstration program focusing on environmental contamination issues faced by the resources sector, especially BHPBIO. BHPBIO's mining activities generate a significant amount of contaminated soil and groundwater at its operations in the Pilbara region of WA. Over the last few years, CRC CARE has conducted research on the assessment and remediation of contaminated sites in this area. In addition to soil and groundwater, BHPBIO uses and needs to dispose of a very large number of timber railway sleepers, many of which include recalcitrant contaminants (e.g. arsenic, copper, chromium, dieldrin and PAHs). CRC CARE has reviewed available technologies to manage and/or remediate the sleepers with a view to developing approaches for safe re-use or recycling.

The CRC conducted trials on the best methods of remediating contaminated soils using biological methods, such as biopile and bioslurry. Both methods were tested and found to be environmentally friendly and economic for the remediation of soils impacted by petroleum hydrocarbons.

This year, CRC CARE completed a large project on the bioremediation of petroleum hydrocarbon-contaminated soil using a biopile technique. Pilot-scale biopile studies were completed in the lab, with results showing that the contaminated soil was amenable to bioremediation when the conditions were optimised for microbes to break down the hydrocarbons. These results were scaled up to field level and a large, optimised biopile was set up at a remote mining site in the Pilbara. The field-scale trial resulted in the successful bioremediation of around 1000 tonnes of contaminated soil within four weeks. This technology has been named as bioCARE™.

2.1.6.2. Department of Defence Program

Program Coordinator:
Dr Sreenivasulu Chadalavada, CRC CARE

The Australian DoD sponsors a demonstration program focused on contaminants commonly found at DoD sites. This multidisciplinary program involves laboratory and field investigations of potentially contaminated sites, and the testing and validation of innovative technologies developed for site assessment and remediation. CRC CARE technologies and applications are now operational at several DoD sites. This partnership has produced a patentable new product for the international market for the detection of residual contaminants from AFFFs. 2014/15 highlights are outlined here.

BIOREMEDIATION OF TCE-CONTAMINATED GROUNDWATER

There is a substantial interest in sustainable, low-cost and environmentally benign remediation techniques that can reliably eliminate chlorinated hydrocarbon compounds, such as TCE, from groundwater. The selection of suitable remediation technologies depends on the nature of the contaminants and site-specific conditions, as well as technology performance, cost, and environmental impacts. Traditional *in situ* remediation approaches cannot remediate contaminated water to drinking water standards at complex sites. Working with DoD at Edinburgh Royal Australian Air Force (RAAF) base, CRC CARE has developed a cost-effective and green remediation technology for the remediation of chlorinated hydrocarbon compounds.

One of the main constraints to remediating subsurface contamination is the difficulty of transporting remediating agents to target regions. In response, CRC CARE has developed a unique strategy that enables subsurface distribution of carbon sources so that TCE in the groundwater is remediated by increased microbial activity. This innovative sustainable bioremediation remediation technology, which is powered by solar panels, has reduced the site's TCE concentration from nearly 5000 ppb to from 9 ppb – 510 ppb, the upper end of which is close to the NEPM groundwater threshold level.

PERMEABLE REACTIVE BARRIERS FOR TCE TREATMENT

CRC CARE has commissioned full-scale remediation work involving the use of a permeable reactive barrier (PRB) to remediate TCE-contaminated groundwater at DSTO Edinburgh. At this site we operate a treatment plant at the contamination source region using pump-and-treat technology which focuses on remediation of the source area, reducing the contaminant mass to prevent expansion of the TCE plume. Regular performance monitoring of the treatment system is also been conducted by analysing inlet and outlet samples.

CRC CARE conducted a trend analysis of TCE concentrations from 2007 to 2015. The results showed an average reduction in TCE concentrations of 76.8% while the remediation system was operating and thus significant remediation was achieved despite the challenging hydraulic conditions in the aquifer. Based on the trend analysis, CRC CARE is confident that TCE concentrations will be reduced below the Dutch Intervention Limit (the accepted industry standard) of 500 ppb during the next 5 to 7 years.

Performance monitoring of the source area's pump-and-treat remediation system confirms that the treatment system is effective for remediating contaminated groundwater at the site, where chemicals of concern include TCE, and its side products and hexavalent chromium. The effluent after treatment shows that the levels of chemicals of concern were below the limit of reporting of 5 ppb for TCE and 0.5 ppb for hexavalent chromium.

AFFF MONITORING TOOL

AFFF fire retardants are commonly used for fire-fighting throughout the world. As they contain potentially toxic PFCs, there is a need to assess and monitor affected sites long afterwards.

The aim of this project is to identify a solvent-free method that does not compromise accuracy and procedural simplicity when used to characterise AFFF concentrations, and to permit cost effective in-field testing. CRC CARE has developed a liquid solution for determining concentrations of AFFF compounds using a

combination of ethyl acetate and ethyl violet. This easy-to-use reagent is now referred to as astkCARE™ Reagent. The concentrations of AFFF are measured by colour development rather than by a spectrometer.

The key limitations of the reagent are the cost and time required to transport it from one location to another, owing to the presence of liquid solvents that are classified as hazardous and thus require special safety procedures. As a result CRC CARE has also developed a solvent-free method that does not compromise accuracy or procedural simplicity to characterise AFFF concentrations, and to permit cost effective in-field testing. This is a dry powder reagent that is easily and cheaply produced and provides a clear indication of AFFF in solutions. Reliable performance over a broad pH range was demonstrated.

CRC CARE has also developed a highly accurate Surface-Enhanced Raman Scattering (SERS) sensor to produce a digital reading of AFFF contamination levels. Using this sensor, we successfully detected anionic surfactants in AFFF compounds.

MODIFIED NATURAL CLAYS

In an effort to devise novel materials to eliminate current and future contaminants and to treat hazardous wastes, CRC CARE is developing, characterising and conducting treatability studies on two modified natural clays, known as organoclays and exfoliated bentonite. In 2014/15 we tested the modified clay materials for dealing with PAHs, TPH, AFFF compounds and VOCs, which are among the main contaminants at DoD sites. The materials exhibited variable pore size distributions, which has significant implications for contaminant retention, especially of VOCs.

The exfoliated bentonite was found to have a very porous structure which is favourable for taking up various contaminants. Surface area measurement for the material showed that the adsorbtive area of this treated clay was 2.5 times larger than in the natural clay, making it an ideal material for immobilising contaminants in both vapours and water.

The organoclay-treated soil results showed that the novel material is suitable for treating PAH contaminants. Laboratory treatability studies for the exfoliated bentonite clay indicated that effluent concentrations were below detection limits for PFOS, PFOA and TPH. The material also removed 98.6% of TCE vapour.

NOVEL SENSOR FOR MONITORED NATURAL ATTENUATION

The focus of this project was to develop a sensor to monitor benzene in groundwater. In order to achieve this goal, we have isolated a bacterium – *Burkholderia* – that is resistant to benzene, which utilises benzene as its sole carbon source.

We completed genomic DNA sequencing to identify the genes responsible for benzene degradation, allowing development of a sensor that detects benzene at rates up to 10 mg/L in groundwater. Our focus now is to enhance the sensitivity for field application.

Further proteomics studies are enabling us to enhance the biosensor to detect benzene at levels as low as 5 ppb, which is the USEPA regulatory level. Furthermore, we have isolated a benzene-utilising bacterium from benzene-contaminated groundwater to develop a biosensor to monitor natural attenuation using optic fibre technology.

2.1.6.3. National Demonstration Site for Innovative Acid Sulfate Soil Remediation

Project Leader:
Professor Richard Bush, Southern Cross University

CRC CARE's National Demonstration Site for Innovative Acid Sulfate Soil Remediation has gained world recognition for its remarkable achievements and practical solutions in treating extreme acidification caused by land clearing and draining. The 800-hectare East Trinity wetland is located in far north Queensland, adjacent to world-heritage-listed wet tropical forests and close to Cairns. This low-lying area became acidic when it was cleared and drained for sugarcane farming in the 1970s. In partnership with the Queensland Government and SCU, a novel *in situ* soil bioremediation strategy has saved many hundreds of millions of dollars that would have been required for a conventional approach. The improvements to soil health and recovery of the wetland vegetation and aquatic ecological have surpassed expectations. Furthermore, the research is opening new opportunities to explore natural processes to treat otherwise intractable acid sulfate degradation.

At the beginning of the remediation program, the East Trinity site was an abandoned 800-hectare cane farm with extreme acid sulfate soils and extensive bare scald areas encrusted with acidic salts. The process of draining the former wetland inadvertently exposed an underlying mineral pyrite layer to the air, consisting of a naturally occurring iron sulphide that is common in coastal lowlands. The reaction of pyrite with air liberates acid, and this can further react with the soil to leach metal contaminants. The result was a toxic combination of multiple contaminants and intense acidification that reached deep into the subsoil. Untreated, the impacts of acid sulfate soils can persist for decades. Conventional remediation using lime was conservatively estimated to cost in the order of $350 million dollars, an option that was neither economic, nor operationally practicable. This applies to most of Australia's acid sulfate soil degraded lands.

The remediation approach developed at East Trinity has been named Lime-Assisted Tidal Exchange (LATE). It boosts the initial neutralisation of acidity and manages seawater inundation, with the aim of establishing environmental conditions to achieve reductive microbial processes. This approach exploits the activity of the natural microbial community under sub-anoxic conditions to reverse the reactions and impacts of pyrite oxidation.

Although straightforward in concept, our research shows that waterlogging the wetland to drive remediation by reductive microbial processes is not a simple return journey. Some physical and chemical landscape changes are effectively irreversible, such as changes to soil structure and land subsidence. Also, the mineralogy of the acidified landscape includes very stable iron oxide minerals (hematite and goethite), that are not readily available for microbial iron cycling. Much of our research has focused on macro-landscape changes to soil and water quality, with a recent shift to resolving the fundamental microbial processes that drive the remediation.

A recent publication by the team reveals that remediation cannot be attributed to any one particular microbial community, or microbial functional group. For example, iron reducing microbes, although essential in the LATE remediation, do not operate in isolation. Understanding the interrelationships between different microbial communities, particularly those involved in sulphur, carbon, silica, phosphorous and nitrogen cycles, provide a much clearer capacity to predict the potential for soil remediation.

We have examined the microbial community structure and functional guild distribution in the surface soils (to a depth of 20 cm), at locations across the tidal inundation front from (i) sub-tidal (always inundated), (ii) intertidal (regular oscillations of inundation and drainage), and (iii) supratidal (rarely inundated). These locations encompass the dynamic oxidative and reductive redox dynamics at the tidal inundation front.

Whole microbial community 16SrRNA gene diversity within each zone was analysed with consideration to the hydrology, geochemistry and pedology. The results illustrate spatial overlap of iron-, and sulfate-reducing bacteria controlled by parameters such as acidity, redox potential, degree of water saturation, and mineralisation. Further research will provide an understanding of the timing – relative to tidal cycling – of various terminal electron-accepting processes that control acid generation and biogeochemical iron and sulphur cycling. This information will help land managers identify the potential for LATE remediation and its broader application.

Part of the East Trinity project site before (2003, above) and after (2012, below) LATE treatment (Photos: Richard Bush).

2.1.6.4. Waste Program

Program Coordinator:
Dr Jayant Keskar, CRC CARE

CRC CARE's Waste Demonstration Program expands our work in organic waste management to resources beyond those generated by piggeries. One of the main aims of the program is to increase awareness of improved waste management options among industries, businesses and local governments which generate or have to deal with organic waste.

POOCARE™ PIGGERY WASTE REMEDIATION

- CRC CARE developed pooCARE™ technology to help deal with the rising problem of pollution caused by piggery waste in China. During the reporting period, a full-scale design for pooCARE™ has been developed along with costing of materials. This enables potential clients to determine the cost from local suppliers and contractors and expedite the work.

The following tasks were completed in 2014/15:

- confidentiality agreement signed with CP Group
- modification of pooCARE™ system to achieve desired end results as per local pollution control board
- completed a process and Instrumentation diagram for the modified system
- established a bill of material for modified system.

AUTOMATED METHANE POTENTIAL TESTING SYSTEM–II

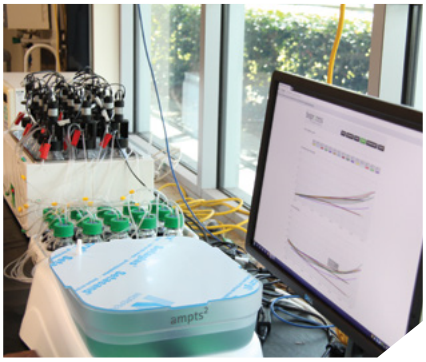
This system assesses the biomethane energy generation potential of organic materials. In 2014/15, several commercial samples were tested, including:

- *Saleyard manure:* manure from Mount Gambier tested and results were submitted to client. Further discussions on feasibility studies to assess electricity generation and biogas utilisation, and to analyse logistics, are underway.
- *Myora Farm piggery:* Piggery waste stream and whey wastewater tested separately and in a mixed state, to determine effect of co-digestion. Preliminary research identified that biogas production is increased with co-digestion, with added value to the digestate, which can potentially be used as a fertiliser.
- *Mushroom waste:* Mushroom waste from a farm at Murray Bridge tested. Huge amounts of waste show potential for biogas generation.

This testing regime is also generating CRC CARE's own database for biomethane potential from different organic substrates.

PUBLIC AWARENESS AND MARKETING

To establish the market in waste-to-energy, CRC CARE delivered information seminars in the Northern Territory, Mount Gambier (SA) and the United Arab Emirates. The Project Coordinator continues to present industry seminars nationally and internationally to raise awareness among industry, policymakers and other stakeholders with the aim of generating income through new projects. As part of the CRC's waste-to-energy marketing plan, workshop costs are offset by participating organisations (e.g. local councils, environmental groups and SME alliances).



CRC CARE's Automated Methane Potential Testing System–II.

2.1.7. CHINA PROGRAM

Program Coordinator:
Dr Hui Ming, UniSA

CRC CARE's China Program, run in partnership with HLM Asia Group Ltd and HUST, consists of three projects:

- A demonstration project of the 'underground river' bioreactor for piggery waste remediation (pooCARE™)
- A project for converting algal blooms from piggery waste to renewable energy
- Phytoremediation of 'red mud' residues with giant hybrid Napier grass.

These projects build on those developed during CRC CARE's first term and are now being scaled up for demonstration and potential commercial adoption.

PIGGERY WASTE REMEDIATION

Piggery waste is a major source of environmental pollution in China, which has around 700 million pigs. The CRC CARE piggery waste remediation system, known as pooCARE™, developed in collaboration with HUST, is capable of converting the waste into biogas and nutrient-rich fertiliser. Further study and testing in this period has focused on developing membrane filtration of the digestate, with very promising results.

One of the largest multinational companies in Asia, CP Group, is interested in adopting pooCARE™ in their pig farming business, but had reservations about cost effectiveness. In early 2015, a new design for the pooCARE™ system for piggery remediation was developed and discussed with end users. Negotiations are in progress with CP Group to conduct a remediation trial in one of their commercial piggeries.

Research during the year focused on investigation of bio-indicators for anaerobic digestion during the remediation of piggery waste with different types of substrates and under various conditions. A laboratory-scale bioreactor was built for this purpose. After 25 days operation, several bio-indicators for measuring system performance were identified.

ALGAE AS RENEWABLE ENERGY

Naturally occurring algae, especially blue-green algal blooms (which can result from excess nutrients in water), can pollute large water bodies and devastate local fish populations. They may also be toxic to humans. However, it is possible to harvest these algae and produce clean energy, thus turning a waste problem into a valuable product.

CRC CARE has focused on algae produced using effluent from piggery waste, and investigated conversion routes from algae to fuel. A research student began this work in in Australia in late 2014, and identified a promising algal strain, *Diplosphaera* sp. The nutrient removal efficiency of dairy wastewater and winery wastewater using *Diplosphaera* sp. has been investigated. The characteristics of algal biomasses harvested from different wastewaters, including elemental content and biodegradable composition, were compared, with the Automatic Methane Potential Test System II used to estimate the biomethane potential of different algal biomasses.

PHYTOREMEDIATION OF RED MUD

Red mud is the highly alkaline waste generated during alumina production; an estimated 100 million tonnes is produced worldwide annually. By cultivating hybrid giant Napier grass on the red mud site – a process known as phytocapping – the residues can be gradually rehabilitated, while yielding substantial biomass for local energy production. Research into Napier grass plantation methods, combined with thorough investigation of red mud characteristics, is enabling CRC CARE to develop a promising solution to the increasingly serious issue of safe red mud disposal in China and elsewhere in the world.

The fast-growing Napier grass can also be harvested and used to produce electricity or methanol for use as a fuel, or biochar for carbon sequestration, and as a soil improver. The process of cleaning up an old red mud site is, therefore, potentially profitable.

Further field work on a larger site with preservable remediation trial was planned in an attempt to attract potential clients to conduct remediation operation in their red mud site using CRC CARE technology. The project is in progress.

SUPPORT FOR CHINESE RESEARCHERS

CRC CARE supported two visiting PhD students from China. Both spent time at CERAR, obtaining advice on setting up an analytical lab at HUST; one also worked with the Program 4 leader on remediation technologies.

AUSTRALIA–CHINA WORKSHOP

CRC CARE held its annual communication workshop in Wuhan, China, in May 2015 in conjunction with HUST, Shaoguan University, and HLM Asia Group Ltd. This event gave CRC CARE's PhD and Masters students in China the opportunity to present their work and exchange research ideas with CRC CARE representatives and their peers. A well-attended workshop saw some outstanding presentations focusing on the remediation of red mud, algae for energy, and the beneficial use of pig waste. Two HUST students currently visiting UniSA also presented their research work by video from Adelaide. Four students were awarded for best science, best presentation and best questioner (two winners).

2.2. Education and training

Program Leader:
Mr Andrew Beveridge, CRC CARE

Through its Education Program, CRC CARE provides scholarship stipends and operational funding for high-calibre PhD and Honours students. The program also provides additional training to CRC CARE students in the development of skills commonly desired by prospective employers. To date, the CRC has awarded over 60 scholarships, spanning all of our major research themes, to candidates across our partner universities. One of the Education Program's main aims is to ensure that the CRC's graduates are industry-ready. In some cases, this is achieved by having students co-supervised by end users.

The CRC's Industry Training Program is designed to ensure that research outcomes and technical knowledge are disseminated to all stakeholders, from industry professionals to government regulators. The CRC uses a number of approaches to share this knowledge, including seminars, webinars, workshops and conferences.

2.2.1. INDUSTRY TRAINING PROGRAM

Translating science into a real-world industry setting is a key deliverable for CRC CARE and its Industry Training Program. By providing opportunities for hundreds of contamination experts annually, this program builds and disseminates professional skills in this field across Australia. In 2014/15, around 600 participants attended CRC CARE training events, either in person or online. Highlights included: a series of workshops in Melbourne and Sydney, presented by visiting USA experts invited by the CRC, on dense non-aqueous phase liquid (DNAPL) and LNAPL site characterisation and groundwater contamination; *Analysis, management and remediation of LNAPL* workshops, which complemented the eponymous Technical Report 34, held in capital cities around the country; and a workshop on *Recent advances in the measurement accuracy for total recoverable hydrocarbon analysis*, hosted by CRC Participant NMI.

SEMINAR AND WEBINAR PROGRAM

The CRC's Seminar and Webinar Program, which began in early 2014 offers a platform from which to engage the wider contaminated land industry on CRC initiatives and research outcomes. Six events in 2014/15 attracted around 300 participants. The seminars are also recorded and offered as on-demand training and educational videos via the CRC CARE website.

Seminars in 2014/15:

1. A unified approach for the analysis, management and remediation of LNAPL in Australia
2. Best practice approaches for ensuring successful bioremediation outcomes
3. Acid sulfate soil: the world's nastiest soil
4. Launch of SCP Australia certification scheme
5. Recent advances in risk assessment for mixed contaminants
6. Who do people trust? A residents' perception of risk communication on industrial contamination

SITE CONTAMINATION PRACTITIONERS AUSTRALIA

In only its first year of operation, SCP Australia – Australia's first accreditation scheme for contaminated site professionals – is recognised as the industry standard. The initiative, developed with support from CRC CARE, was launched in November 2014. To date it has over 100 subscriptions, 26 certified practitioners listed on its directory (http://scpaustralia.com.au/directory/), and endorsements from several state regulators.

To disseminate information about and promote SCP Australia, its Executive Officer has conducted face-to-face meetings and presentations nationally with all stakeholders, including state EPAs, ACLCA and ALGA state branches, and local government organisations.

SCP Australia communicates regularly with regulators, some of which have already incorporated practitioner certification into their regulatory processes. EPA Tasmania has introduced regulations requiring SCP Australia-certified practitioners to be used from 1 July 2015 whenever contaminated site assessments require EPA input or approval. Feedback from EPA Tasmania has been very positive and they continue to endorse the scheme exclusively. The NSW regulator has also announced their support for certification schemes, including SCP Australia, and plans to make certification a requirement for reports submitted to EPA NSW.

Two other consultant organisations have launched certification schemes for contaminated site practitioners within the framework of their mainstream certification programs. The Environmental Institute of Australia and New Zealand (EIANZ) offers a contaminated land specialisation within their Certified Environmental Practitioner (CEnvP) scheme (launched in December 2014), and Soils Science Australia has a contaminated land specialist stream within their Soil Science Certification (launched mid-2015). As of the end of the reporting period, neither scheme had announced its register of certified contamination practitioners. CRC CARE has been in discussion with EIANZ about how the two organisations might work together and avoid unnecessary or confusing competition.

SCP Australia aims to be the certification provider of choice for contaminated sites through ongoing liaison with industry, regulars and consultant organisations, and by providing timely customer responses to queries. Through the SCP Australia website and social media, the scheme provides regular information and feedback on certification processes and issues (e.g. http://scpaustralia.com.au/resources/scpa-news/)

2.2.2. EDUCATION PROGRAM

In 2014/15, the CRC engaged four new PhD students and three Honours students. Ten PhD, one Masters and four Honours students graduated (plus one PhD graduate who started in the CRC's first term of funding), and 41 PhD students were continuing their study as of 30 June 2015. It is extremely pleasing to note that, with five years of Commonwealth funding remaining, the CRC has already met its target PhD numbers in the Commonwealth Agreement.

In addition to these honours and awards, it has been pleasing to see the level of student participation in the CRC's industry training program. CRC CARE students made a significant contribution to CleanUp 2013, with approximately 30 CRC-supported students submitting papers for consideration. Attendance at industry training program activities supports the CRC's objective of developing the students' transferable and functional skills expected by future employers.

Education Program highlights in 2014/15 are summarised here.

- In September 2014, the CRC held its biennial Communicate Conference, which brings together all students and researchers involved in CRC CARE projects around the country in a bid to create a shared vision for the CRC research efforts. The conference promotes the sharing of knowledge, information and achievements, and reinforces links between CRC CARE researchers, management and students. Around 100 delegates attended the event, which also included career skills workshops for students.
- Each year, a Chinese version of Communicate – the 'Commun Workshop' – is held in Wuhan, China, for CRC CARE-sponsored PhD students at HUST. Attended by CRC staff and Board representatives (including the Managing Director), Commun gives students the opportunity to present their research in English, with audience members required to ask questions in English. Awards were presented for best science, best presentation and best question.
- PhD student Vidhyasri Subramaniyam won best poster presentation at the 2014 SA Polymer and Bionanotechnology Symposium in August.

2.2.3. CRC CARE STUDENTS IN 2014/15

NEW HONOURS STUDENTS (AUSTRALIA)

Student name	Program	University	Thesis title	Expected completion
Stephanie Hodby	3	UQ	Special characterisation of metals and arsenic in environmental and biological systems by synchrotron-based systems	15/16
Katherine Jordan	2	UQ	Assessment of novel cell-based bioassay sensitivity to nanoparticles	15/16
Shelby Priscilla Siew Ling Su	2	Curtin	Development of novel nanocarbon for extractive analysis and remediation	15/16

HONOURS GRADUATES (AUSTRALIA)

Student name	Program	University	Thesis title
Kaihong Yan	3	UniSA	Define measurements to generate data for input into the risk and compliance model to identify assumptions and minimise uncertainty
Shankar Bolan	3	UniSA	Heavy metal(loid)s in complementary medicines
Dijana Jerkovic	3	UniSA	The assessment of PAH bioaccessibility using *in vitro* assays and absorption sinks
Michael Wong	4	Curtin	Catalytic oxidation of POPs in water

NEW PhD STUDENTS (AUSTRALIA)

Student name	Program	University	Thesis title	Expected completion
Emily Hepburn	2	RMIT	Integrated decision-making methodology and tools for groundwater remediation	17/18
Jonás García Rincón	4	UTS	Multiphase modelling of LNAPL remediation options in aquifers with complex geology	17/18
Wenjie Tian	2	Curtin	Development of novel nanocarbon materials for extractive analysis and remediation	17/18
Dakota Gibbs	4	SCU	Investigation of Fe Biogeochemistry (focusing on stable Fe isotope fractionation) of an acid sulfate soil wetland	17/18

MASTERS GRADUATES (AUSTRALIA)

Student name	Program	University	Thesis title
Adi Maoz	3	UniSA	Ecotoxicity of zero-valent iron nanomaterials to microorganisms involved in contaminant biodegradation

PhD GRADUATES (AUSTRALIA)

Student name	Program	University	Thesis title
Laura Chekli	2	UTS	Development of methodologies for the standard characterisation of zero-valent iron nanoparticles and their complex environmental interactions using field-flow fractionation
Zhiqiang Wang	4	UniSA	Synthesis of iron-based nano-particles using plants and application in oily contaminant remediation
Saranya Kuppusamy	4	UniSA	Development of a formulation of microbial inoculum for field-scale remediation of polycyclic aromatic hydrocarbons
Srinithi Mayilswami	3	UniSA	Earthworm biomarkers for monitoring persistent organic pollutants
Anithadevi Sivaram	4	UniSA	Phytoremediation of PAH-contaminated soils
Biruck Desalegn Yirsaw	4	UniSA	Application of nanotechnology and chemical oxidation to remediate oil sludge contaminated soil
Jaeyeob Jeong	4	UniSA	Carbon sequestration and soil respiration following forest fertilisation in Korea
Prasath Annamalai	4	UniSA	Environmental fate and behaviour of explosives: Potential remediation approaches
Ramya Thangarajan	4	UniSA	Nitrogen transformation and nitrous oxide emission from organic amendments
Tanjina Nur	4	UTS	New adsorbents for removal of inorganic contaminants from water
Shiva Prakash	CARE I – Risk Assessment	UQ	Toxicological studies of inhalable iron-rich particles with and without adsorbed chemical species relevant to mining industry health and safety

Programs

1. Best Practice Policy
2. Better Measurement
3. Minimising Uncertainty in Risk Assessment
4. Cleaning Up

CONTINUING PhD STUDENTS (AUSTRALIA)				
Student name	**Program**	**University**	**Thesis title**	**Expected completion**
Aaron Katz	4	UTS	Novel solar-driven fibreoptic photocatalysis hybrid system for groundwater treatment	15/16
Ali Ijaz	4	UWS	A bioinformatics pipeline for improved analysis of shotgun metagenomic data	16/17
Cameron Ollson	3	UniSA	Mineralogical constraints associated with contaminant bioaccessibility in mine- and smelter-impacted soils	16/17
Chen Wang	4	Curtin	Natural clay mineral–graphene composites for sustainable remediation	16/17
Danious Sounthararajah	4	UTS	Heavy metal/metalloids remediation from drinking water by innovative adsorbents	16/17
Eileen Li	4	UQ	Potential factors limiting plant growth in saline bauxite processing residue	16/17
Evangelos Gatsios	4	UTS	Evaluation of LNAPL remediation technologies	16/17
Fangjie Qi	4	UniSA	Interactions of black carbon with contaminants in soil	16/17
Firouz Abbasian	4	UniSA	Metagenomic studies for detection of biodiversity in polluted soils and investigation for TPH degrading genes	16/17
Gabriel Lago	4	UTS	Quantifying the risk due to LNAPL removal from impacted sites	16/17
Gulliver Conroy	1	UniSA	The professional shaping of nanotechnology: a boundary perspective of communication for environmental risk governance	15/16
Gurwinder Singh	3	UniSA	Fate and transport of metal(loid)s in aged and mixed contaminant environments	16/17
Hao Hu	2	UQ	Developing mechanism-based bioassay for predicting toxicity of environmental contaminants	15/16
Kate Hughes	1	UTS	Community perceptions and context in decision making for contaminated site remediation	15/16
Kerry Scott	1	UniSA	Classification and ranking of incentives for remediation and reduction of title blight	18/19
Khandaker Rahan Mahbub	4	UniSA	Bioremediation and monitoring of mercury	16/17
Mahatheva Kalaruban	4	UTS	Adsorptive removal of nitrate from drinking water using chemically modified adsorbents	16/17
Mike Van Alphen	CARE I – Risk Assessment	UniSA	The characterisation of fibre bundles and the release of respirable asbestos fibres	15/16
Mohammed Kader	3	UniSA	Environmental risk assessment of nanomaterials for soil and groundwater remediation	16/17
Muhammad Khan	4	UniSA	Evaluation of the residual toxicity of hydrocarbon-contaminated soils	15/16
Muhammad Mughal	2	Curtin	Wind prediction modelling and validation using LIDAR data	14/15
Pandian Govindarasu	4	UniSA	Illicit drugs in the environment: toxicity and remedial options	15/16
Qing Xia	3	UQ	Assessing risk to humans: arsenic, cadmium and lead as mixed contaminants with polycyclic aromatic hydrocarbons	15/16
Raghupathi Matheyarasu	4	UniSA	Nutrient management from wastewater-irrigated soils	15/16
Rajasekar Karunanithi	4	UniSA	Phosphorus recovery and reuse from waste streams	16/17
Samuel Aleer	4	UniSA	Metagenomics: screening of functional genes associated with polycyclic aromatic hydrocarbon biodegradation in contaminated soils	15/16
Sasikumar Muthusamy	3t	UQ	Evaluation of interaction toxicity of polycyclic aromatic hydrocarbons and metals	15/16
Shizhen Liu	4	Curtin	Graphene oxide and graphene-based catalysts in photochemical reactions	15/16
Shofiqul Islam	3	UniSA	Arsenic in rice: genotypic variation and its bioavailability with respect to human health risk assessment	16/17
Smriti Rayu	4	UWS	Methane assisted bioremediation: evidence from metagenomics	14/15
Sonia Shilpi	4	UniSA	Wastewater driven biomass production for energy generation	15/16
Tao Hua	4	UQ	Potential of constructed wetlands to treat drainage from bauxite residue disposal areas	15/16
Thu Chung Nguyen	4	UTS	Road-deposited sediment pollutants: analytical techniques for mobility, bioavailability and remediation	15/16
Vaibhav Mohale	2	Curtin	Plume studies using doppler LIDAR and dispersion modelling	14/15
Victor Indasi	2	Curtin	Windfield investigations at Lake Turkana wind farm in Kenya	14/15
Vidhyasri Subramaniyam	4	UniSA	Biological synthesis and evaluation of nano-scale iron particles for remediation of contaminated soil and ground water	15/16
Vilma Faustorilla	2	UniSA	Accurate measurement of total petroleum hydrocarbon in soils and sediments	16/17
Vimal Kumar	4	UniSA	A cost-effective method for remediating wastewater using algae coupled with simultaneous production of biofuels	14/15
Vincent Lal	3	UQ	Health risk assessment of mixed contaminants: interactions of metals on the uptake of polyaromatic hydrocarbons in human liver cells	16/17
Ying Cheng	4	UniSA	Green synthesis of iron nanoparticles and their application as a catalyst for the degradation of TPHs in ground water	16/17
Yuxian Wang	4	Curtin	Application of magnetic carbon nanospheres loaded with metal oxide to generate active species for remediation of organic pollutants	15/16

CONTINUING PhD STUDENTS (CHINA)				
Student name	**Program**	**University**	**Thesis title**	**Expected completion**
Mian Hu	4	HUST	Study of biomass pre-treatment to produce biochar and application	15/16
Qunpeng Chen	4	HUST	Anaerobic digestion of pig waste	15/16

Programs

1. Best Practice Policy
2. Better Measurement
3. Minimising Uncertainty in Risk Assessment
4. Cleaning Up

2.3. Small-to-medium enterprise engagement

CRC CARE pays particular attention to building the mechanisms and structures to engage with not only our 28 Participants, but also the broader industry, especially Australian SMEs. This recognises the strategic value to Australia of having an internationally competitive, innovative and highly skilled local industry to protect both human and environmental health and grow sustainable Australian businesses.

Our engagement mechanisms include: face-to-face meetings, technical reports, our seminar and webinar program, industry training workshops, hosting and participating in stakeholder and policy groups, industry-focused print and online publications, national and international conferences, our website, project reports, newsletters, and other methods of direct contact.

Since its establishment, CRC CARE has had a long-standing relationship with ALGA, ACTRA, and ACLCA – member-based organisations that represent Australian contaminated land consultants, risk assessors and environmental service providers. We rely on the support of ACLCA (a CRC Participant) and ALGA (an organisation initiated by the CRC early in its first term of funding) to disseminate knowledge of the CRC's strategic activities and projects to consulting and service-providing SMEs throughout the industry.

Contamination and remediation is a highly contested space, with stakeholders often holding competing interests. CRC CARE aims to provide an independent evidence base enabling these interests to come together and be mediated. In this context, stakeholder engagement in general, and SME engagement in particular, is at the core of our operations and central to their success.

SME engagement in 2014/15 included the following:

- After more than one year working with ACLCA and ALGA on Australia's first accreditation scheme for contaminated site professionals, SCP Australia was launched in November 2014.
- ACLCA and ALGA continued to provide input towards the CRC CARE-led development of a National Remediation Framework (see *Program 1* on page 10).
- ACLCA and ALGA also continued their involvement in the CRC CARE's LNAPL Forum – an industry group whose members represent the resources sector and research organisations operating in this area.
- JBS&G helped CRC CARE scale up a number of remediation technologies.
- The CRC worked closely with FibreCell Australia on the Program 4 project *Nutrient management from wastewater discharged from abattoir*.
- CRC CARE Technical Report 34: *A practitioner's guide for the analysis, management and remediation of LNAPL* was published; SMEs in the environmental consultancy and site remediation industries are a key target audience for this publication.
- The CRC was a major sponsor of Ecoforum 2014, which is a focus for many SMEs in the contaminated site management industry. Our exhibition booth and presentations by several CRC staff ensured strong engagement.

WORKSHOPS AND SEMINARS

In 2014/15, CRC CARE continued to co-run workshops and seminars with and/or for SMEs, both directly and via industry groups. These included:

- ALGA invited NMI to present at a series of forums on Australia's first proficiency study for PFOS and PFOA.
- *Analysis, management and remediation of LNAPL* workshops, which complemented Technical Report 34, were held in capital cities around the country.
- The CRC's Seminar and Webinar series covered a range of SME-relevant topics (e.g. best-practice bioremediation, acid sulfate soils, risk assessment, and risk communication).
- A series of workshops in Melbourne and Sydney, presented by visiting USA practitioners, on DNAPL and LNAPL site characterisation and groundwater contamination.

WASTE PROGRAM

With a range of SMEs, along with state and local government, CRC CARE co-ran workshops on waste-to-energy technologies, both directly and via industry groups. SMEs were also a key target audience. These were held in both metropolitan and rural locations in SA, Tasmania, Victoria, Northern Territory. The CRC continued to offer its biomethane potential testing service, which was utilised by several SMEs, including pig farms, a wool processor and a livestock saleyard.

03 RESULTS

3.1. Utilisation and commercialisation

In 2014/15, three of the four utilisation milestones due for completion were achieved.

Utilisation milestones due in the next reporting period have been evaluated and strategies developed to support their achievement.

The one uncompleted utilisation milestone, from Program 3, was delayed because a literature search demonstrated the need for multiple sub-risk assessment models that would contribute to the risk and compliance model. While a vapour intrusion model has been developed, work on a model incorporating bioavailability requires a lot more research than previously anticipated, resulting in significant delay in the delivery of risk compliance model

To support the adoption by end users of research outputs, around 600 environmental managers were trained during the reporting period. Furthermore, one Masters student and eleven PhD students completed their study, enabling their entry into the workforce and thus facilitating the take-up of research outputs.

CRC CARE progressed its assessment of commercialisation/utilisation arrangements with industry. This includes engaging small SMEs and other end users that are candidates to adopt several technologies. This assessment has provided a platform for development in future years.

Further information on the specific utilisation and commercialisation activities of CRC CARE can be found throughout various sections of this report. A summary of these activities includes:

- the production of technical reports, publicly available on the CRC CARE website
- workshops and training offered to industry professionals
- the submission and maintenance of patent applications
- activities of the NCSDP (see pages 16–19)
- Following inclusion of the CRC's HSLs in the amended NEPM in 2013, the CRC continued to promote its training DVD on the use of the HSLs
- The launch of SCP Australia, Australia's first accreditation scheme for contaminated site professionals, which already has over 100 subscriptions, with 26 certified practitioners listed on its directory and endorsements from several state regulators
- support provided to PhD and Honours students, who work in conjunction with CRC CARE researchers on research activities
- the publication of journal papers and presentation of conference papers (a full list for the financial year can be found in section 7, *Publications*).

CRC CARE PATENTED TECHNOLOGIES

The following table summarises CRC CARE's pending patent families. Each technology is outlined on the following pages.

PATENTS AND PATENT APPLICATIONS HELD

Anionic surfactant detection (astkCARE™)	
National phase applications in Australia, Japan and USA	
Australia and Japan	Granted (Divisional application filed in Australia – Granted)
USA	Allowed

Modified clay sorbents (matCARE™)	
National phase applications in Australia, Canada, Europe and USA	
Australia	Granted
Canada	Examination requested
Europe and USA	Under examination

Amine modified clay sorbents (matCARE™)	
National phase applications in Australia (AU2010330678) and the USA (US13/514,572)	
Australia	Granted
USA	Under examination

Improved gravity sedimentation process and apparatus (sonicCARE™)	
National phase applications in Australia, Brazil, Canada, Europe, Indonesia, Peru, South Africa and USA	
Australia and South Africa	Granted
Brazil, Canada, Indonesia, Peru and USA	Pending (Examination yet to commence)
Chile	Under examination

Analyte ion detection method and device (probeCARE™)	
National phase applications in Australia, Canada, Europe and USA	
Australia	Granted
Canada, Europe and USA	Pending (Examination yet to commence)

A system for processing organic waste (pooCARE™)
International PCT application no. PCT/AU2014/000137

A method and apparatus for automatically determining volatile organic compounds in a sample (btexCARE™)
Provisional patent application no. 2015901951

Method of recalibrating a device for assessing concentration of at least one analyte ion in a liquid (probeCARE+™)
Provisional patent application no. 2015900933

TRADE MARKS HELD

CRC CARE – combined word and image mark
Australian registered trade mark no. 1150159

matCARE – word mark
Australian registered trade mark no. 1352133

pooCARE – word mark
Australian registered trade mark no. 1487165
Chinese accepted trade mark nos. 11607975 and 11607976

globalCARE – word mark
Australian registered trade mark no. 1637278
USA, Europe, Chinese and Norway trade mark applications - Pending

Anionic surfactant detection (astkCARE™)

The anionic surfactant test kit has been developed to provide a safe, sensitive and reliable method to detect and measure the concentration of highly toxic surfactants in the environment. These surfactants can come from industrial and institutional cleaning solutions, industrial effluent or applications such as AFFFs, or even personal hygiene products such as soaps, shower gels and domestic cleaning solutions. The low rate of biodegradability and residual toxicity of AFFFs and the effects of background levels of alkyl benzene sulfonates (which can affect reproduction of aquatic organisms) are two issues of environmental concern.

This technology has been a significant development as part of the DoD demonstration program and astkCARE™ kits are in wide use across RAAF bases. astkCARE™ benefits include:

- simple to use, does not require highly skilled operators and can be used in the field
- achieves rapid results
- cheaper and safer than established techniques that rely on hazardous solvents such as chloroform, which is used in existing methylene blue active substances (MBAS) assays
- high specificity and reliability.

The ASTK research continues to evolve, with work now proceeding towards colour-response strips together with electronic sensing. This ongoing research targets safety, accuracy and cost-effectiveness through the availability of in-field performance technology. The technology is at an early stage of commercialisation.

Modified clay sorbents

This remediation product is being developed for removal of problematic pollutants, including some of those featured in the Stockholm Convention on persistent pollutants. These pollutants represent serious hazards to humans and animals. This technology:

- is cheap, effective, easy to use
- uses recoverable materials
- requires the use of standard industrial plant, low-skill operators and low-cost equipment
- is applicable to major remediation problems and contaminated brownfield sites.

Amine-modified clay sorbents (matCARE™)

CRC CARE developed this remediation product, known as matCARE™, to remove toxic contaminants such as AFFFs and those on the Stockholm Convention list. matCARE™, an amine-modified clay, has undergone field trials and has now been dispensed or sold to the DoD at four sites, and to Airservices Australia at one site. AFFFs are widely used in fire-suppression systems because of their superior fire-fighting properties. AFFFs contain potentially harmful PFCs – stable chemicals that do not change or break down readily in the environment or in living things. PFCs are often present in soil, sediments and water where AFFFs have been deployed. matCARE™ removes PFCs from wastewater and soil. The product is at an advanced stage of commercialisation.

Improved gravity sedimentation process and apparatus (sonicCARE™)

A patent has been filed with partner organisations for this new technology resulting from a PhD project on settling and dewatering in mineral tailing processing. Demonstrated on a laboratory scale, the next step will involve pilot-scale trials in an industrial process plant. CRC CARE's research program identified that applying ultrasonic energy to the tailings from mining operations can save water over and above current conventional technologies. This energy is applied after flocculant addition and enables further compaction of waste materials, thereby releasing more water. Our internal project name for this initiative is sonicCARE™.

Mining accounts for 2% of Australia's total water use, so small percentage reductions in water use in mineral processing can represent large amounts of water saved. Mineral processing typically needs 0.4–0.6 tonnes, or 500 litres, of fresh water for every tonne of ore ground. It is estimated that the world produces more than 10 billion tonnes of tailings waste every year, typically consisting of 60–95% water. However, it is widely recognised that the processes used to separate liquids from solids are inefficient. sonicCARE™ is at an early stage of commercialisation and is currently undergoing testing in the mining industry.

Analyte ion detection method and device (probeCARE™)

CRC CARE has developed a novel technique for the real-time measurement of metal ions in solution using Ion Selective Electrode Arrays. The technique includes software that has been developed to allow real-time measurement of a multitude of free ions simultaneously in solution. probeCARE™ allows common ions such as sodium, potassium and calcium to be measured in complex solute matrices, even in coloured solutions. This is of value to agricultural irrigators and for monitoring water quality in lakes and streams. Existing techniques utilise laboratory equipment whose size and weight render them inappropriate for in-field measurements. Consequently, process time and equipment costs can be prohibitive.

probeCARE™ supports cost-effective, *in situ*, real-time monitoring, together with improved management strategies for cropping, improved fertigation (applying fertilisers or other soil amendments through an irrigation system), effective use of recycled water, and monitoring for possible pollutants to ensure EPA standards are achieved. probeCARE™ is being developed with internet connectivity to truly support remote sensing and continuous monitoring of critical resources. The technology is at an early stage of commercialisation.

probeCARE+™ utilises specially developed mathematical equations to simulate the response values of an Ion Selective Electrodes (ISE) array, and to determine the analytes' concentrations from unknown samples. probeCARE+™ is particularly practical for end users because a small number of standard solutions need to be measured for the ISE array to be automatically recalibrated using a genetic algorithm.

A system for processing organic waste (pooCARE™)

As part of its China Program, CRC CARE has developed a two-step underground anaerobic bioreactor – patented as pooCARE™ – for treating piggery waste. The project is being managed by HLM Asia Group Ltd, and involves collaboration with Chinese scientists from HUST. A particular combination of anaerobic treatments is used to produce clean biogas energy and recover nutrients for use as fertiliser and other valuable products. The system has great potential for application in other livestock industries worldwide.

Advantages of the technology over many existing designs include:

- small footprint (in comparison to conventional treatment systems such as covered anaerobic lagoons)
- improved biogas generation
- operates well all year round, even in cold temperatures
- low maintenance requirements
- low electricity requirement (potentially self-powering)
- constructed as a modular system
- bioenergy production.

Better management of BTEX emissions (btexCARE™)

Petroleum products such as gasoline and diesel fuel contain various VOCs, many of which are known carcinogens. The most dangerous VOCs in petroleum products and natural gas are benzene, toluene, ethylbenzene and xylene, which are known collectively as the BTEX components. Workers may be exposed to BTEX during refining operations, gasoline storage, shipment and retail operations, chemical manufacturing, plastics and rubber manufacturing, shoe manufacturing, printing, and activities in chemical laboratories. All manufacturing companies need to manage BTEX emissions in accordance with their country's EPA regulations as well as workplace health and safety guidance.

To better manage BTEX emissions, CRC CARE developed novel methodologies for automatically determining and monitoring BTEX components using Fourier transform infrared (FTIR) spectra. These methodologies include:

- an object-oriented baseline correction
- a curve fitting method with mathematical optimisation
- a neural network technique for determining BTEX components.

After they have been programmed and configured, these methodologies can be applied to an FTIR system for online *in situ* BTEX monitoring of PHC-contaminated sites.

3.2. Intellectual property management

During the 2014/15 reporting period, CRC CARE had the following patent families and applications.

- Five patent families at the national phase application stage:
  - *Modified clay sorbents*
  - *Amine modified clay sorbents*
  - *Anionic surfactant detection*
  - *Improved gravity sedimentation process and apparatus*
  - *Analyte ion detection method and device).*
- One patent family at the Patent Cooperation Treaty (PCT) application stage:
  - *A system for processing organic waste.*
- Two provisional patent applications:
  - *A method and apparatus for automatically determining volatile organic compounds in a sample*
  - *Method of recalibrating a device for assessing concentration of at least one analyte ion in a liquid).*

The CRC has four trademarks registered in Australia (pooCARE™, matCARE™, globalCARE™ and CRC CARE – word and image), and two marks have been approved in China (pooCARE™ in Classes 11 and 40).

All of CRC CARE's new technologies are in commercial development, with potential commercial applications being defined. The focus to date has been on securing appropriate agreements with end users – such as site operators, remediation contractors, manufacturers and suppliers of equipment – for evaluation. Continuing protection of intellectual property (IP) is important until the commercial potential has been fully assessed.

CRC CARE has the essential mechanisms in place to ensure adherence to the National Principles of IP Management. Provisions within the Commonwealth and Participants' Agreements provide the key elements for IP management. In addition to the Agreements, CRC CARE has implemented appropriate policies and procedures, including those for:

- identification and disclosure of IP
- assessment of existing IP
- protection of IP
- record keeping via an IP register
- business case development and approval
- benefit sharing.

No registered IP was sold, transferred or licensed for commercialisation during the reporting period.

3.3. Communications

CRC CARE's communication strategy underpins the delivery and dissemination of the CRC's outputs. It also aims to increase public awareness of CRC CARE and its work both nationally and internationally, so as to further expand the growing recognition of the CRC as an international centre of excellence and an independent expert voice on contamination and remediation issues. As the CRC moves towards cessation of Commonwealth funding in 2020, it is increasingly seeking to commercialise its knowledge and products. In this context, communication is taking on more of a marketing focus.

3.3.1. INDUSTRY, RESEARCH AND GOVERNMENT STAKEHOLDERS

The CRC directs much of its communication efforts at its industry market, made up primarily of businesses and consultants dealing with contamination assessment and remediation in mining and mineral processing, fuel storage and transport, land development, manufacturing and waste. In the public sector, key players include regulators as well as managers of large areas of land with a history of industrial or chemical use, such as airports and the DoD. All these groups include CRC Participants.

CRC CARE TECHNICAL REPORTS

Completed research is not only published in peer-reviewed journals, but also in CRC CARE's Technical Report series. This comprises a comprehensive collection of work carried out by the CRC and its partners, published to address technical issues of importance to industry and government. These are made available to users via the CRC's website and in some cases (e.g. anticipated high demand) in print form. Two new Technical Reports were published in 2014/15 (see page 58). The CRC also completed three technical or guidance reports for DoD, and three for Petroleum Program Participants.

SEMINAR AND WEBINAR PROGRAM

This initiative, in its second year, is an excellent example of the CRC's commitment to disseminating knowledge to professionals working in the contaminated land industry. Seminars are presented by CRC experts or renowned external national and international experts invited by CRC CARE. Presenters come from a wide pool that includes researchers, regulators and industry practitioners, with a view to providing knowledge that supports both researchers and SMEs. Six seminars were held in 2014/15 (see page 21 for more details).

REMEDIATION AUSTRALASIA

Remediation Australasia, CRC CARE's industry-targeted magazine, informs the Australasian remediation industry about new research and developments that may influence their business, and aims to help them meet the challenges of dealing with contamination. As a result of the work involved in CRC's relocation to Newcastle, as well as the attendant loss of staff capacity, the magazine was put on hold in 2014/15 (with publishing recommencing in September 2015). Subscription to *Remediation Australasia*, in hard copy or as a PDF, is free. All issues are also available to non-subscribers for free PDF download from the CRC's website. The publication's more than 2000 recipients span the breadth of CRC CARE's stakeholders: industry participants, environmental consultants, regulators, government departments and agencies, universities and other research organisations.

CONFERENCE REPRESENTATION AND SPONSORSHIP

As part of its effort to communicate its scientific findings, CRC CARE researchers regularly attend national and international conferences. To further enhance its visibility in the research sector, the CRC also sponsors key events in its field, receiving prominent exposure via branding, acknowledgements and exhibition booths. In 2014/15 CRC CARE was a major sponsor at ALGA's EcoForum Conference, in October 2014 in Gold Coast, Queensland. Several CRC CARE staff and researchers (including the Managing Director) also gave presentations at this industry-focused event.

WEBSITE

The website is an essential part of the CRC's information delivery strategy. Redeveloped in 2013/14, the new site provides the CRC with a modern, consistently branded online presence. Compared with the previous site, it better integrates with social media, improves contact database management, facilitates email-marketing campaigns (e.g. electronic newsletters and event promotion), and improves event registration and payment systems.

NATIONAL WORKSHOP ON NUCLEAR ENERGY FOR AUSTRALIA

In June 2015, CRC CARE hosted a National Workshop on Nuclear Energy in Adelaide, SA, with sponsorship from NIER and the University of Newcastle. As well as focusing on the CRC's specialties of risk and waste management, the event included sessions on the cases for and against nuclear energy. This was a very timely event, given that between the decision to organise it and the workshop itself, the SA Government established a Nuclear Fuel Cycle Royal Commission. Over 60 people from a range of industries (and positions on the debate) attended, including Royal Commissioner the Honourable Kevin Scarce; Senator Sean Edwards, Liberal Senator for SA, who closed the workshop; and Mark Parnell MLC, parliamentary leader of the SA Greens. As well as encouraging public debate on the issue of nuclear power, the event:

- allowed CRC CARE to engage potential stakeholders in the nuclear area
- helped ensure that the CRC is positioned to be involved in nuclear waste management in the future, should Australia opt for nuclear power or develop a waste disposal industry for other nations.

The workshop also generated broadcast and online media for the CRC, including interviews with the Managing Director on ABC radio.

3.3.2. PUBLIC AWARENESS

Another area of the CRC's broad communication effort involves generating broader public awareness. To this end 7 press releases were issued in 2014/15. The CRC also maintains a range of non-technical material on its website, such as brochures and fact sheets.

MEDIA RELEASES ISSUED IN 2014/15

CRC CARE media releases (all available at www.crccare.com/news-and-media/media-releases):

- *Who do Australians trust on 'toxic news'?* – 7 April 2015
- *Exploring Australia's nuclear future* – 19 March 2015
- *Expanding Australia's contamination science effort* – 3 March 2015
- *Cleaning up an oily threat – new remediation guidelines for petroleum contamination* – 9 February 2015
- *New guide shields Aussies from toxic groundwater, land* – 21 October 2014
- *Aussie answer to toxic fire-fighting chemicals* – 6 October 2014
- *Leading contamination expert endorses 'Poisoned Planet'* – 4 July 2014

MEDIA HIGHLIGHTS IN 2014/15

- Managing Director Prof. Ravi Naidu was interviewed on radio and quoted in print and online news publications on a wide range of topics, most notably:
  - Interviewed on Adelaide radio stations ABC 891 and 5AA, as well as quotes in *The Advertiser* and several online media outlets in response to industrial contamination that forced the evacuation of a number of residents in an Adelaide suburb
  - Interviewed on ABC Radio National's Life Matters program on the issue of global contamination of the environment
  - Coverage in *The Australian* of CRC CARE's work on managing AFFF contamination, after the CRC was named as a finalist in The Australian Innovation Challenge 2014.
- Program 1 Leader and CRC CARE Executive Policy Adviser Dr Bruce Kennedy quoted in the highly respected *Carbon & Environment Daily* about the CRC's work on the National Remediation Framework.
- Prof. Richard Bush (SCU), who leads the CRC's Acid Sulfate Soil Demonstration Program, was quoted by several sources (including ABC radio, *The Australian*, *The Guardian Australia* and Sky News) on the risks of acid sulfate soil problems if dredging was to occur at Abbot Point, Queensland.
- Waste Demonstration Program Leader Dr Jayant Keskar was interviewed about his biogas and waste-to-energy seminars on ABC TV Tasmania and ABC Rural radio in Tasmania and Northern Territory.
- CRC CARE-supported research on risk communication by Dr Jason Prior (UTS) was featured in the *Sydney Morning Herald.*

AWARDS AND RECOGNITION

An important part of CRC CARE's public awareness effort is via recognition of its work. When opportunities arise, the CRC nominates its people, science and technologies for national and international awards. In 2014/15, the CRC was named as a finalist in the Environment, Agriculture and Food category of *The Australian Innovation Challenge* 2014 for its work to develop a highly effective technology for remediating AFFF contamination (matCARE™).

3.3.3. SOCIAL MEDIA

CRC CARE continued to grow its social media presence in 2013/14. The CRC's key social media channels are as follows:

SOCIAL MEDIA PLATFORM	WEB ADDRESS	KEY AUDIENCE(S)	PURPOSE
Facebook	www.facebook.com/CRCCARE	Early-career researchers (current and former PhD students/Postdocs), as well as some more senior researchers and members of the public.	Updates on CRC achievements, awards, publications and events; non-CRC contamination issues and research of interest.
LinkedIn industry group	http://linkd.in/1sUoIBB	Industry (e.g. contaminated site practitioners).	Updates on CRC publications and events and research results; policy developments.
LinkedIn company page	www.linkedin.com/company/crc-care	Participant representatives (research and industry), CRC staff.	Updates on CRC achievements, awards, publications and events.
Twitter	www.twitter.com/crccare	Mixed: industry, government, media, students, researchers and the general public.	Updates on CRC achievements, awards, publications and events; links to research papers and news articles of interest.

The CRC has also created a YouTube channel (www.youtube.com/crccare) to promote its research. As of 30 June 2015, there were 20 videos available, with eight added since the previous reporting period. Eleven of the videos feature CRC CARE PhD students and postdocs explaining their work in non-technical terms, as part of their entries for the annual CRC Association Early Career Researcher competition.

Social media followers continued to rise steadily in 2014/15:

SOCIAL MEDIA PLATFORM	ENGAGEMENT AS OF 30 JUNE 2014	ENGAGEMENT AS OF 30 JUNE 2013	% CHANGE
Twitter profile	610 followers	413 followers	+ 48
LinkedIn industry group	689 members	613 members	+ 12
LinkedIn company page	673 followers	367 followers	+ 83
Facebook page	290 likes	175 likes	+ 66

The total reach of the CRC's Facebook page (defined as the number of people who were served any activity from the page, including posts, posts by other people, mentions and check-ins) in 2014/15 was 71,189 of which 17,669 were organic and 53,520 were paid. This included 1600 visits to our timeline (a 23% increase on 2013/14). Organic reach increased by 47%, and overall reach was almost six times greater than last year's (bolstered by paying a relatively small amount to increase reach for selected important posts).

3.3.4. POLICY COMMUNICATION

A third area of communication attention for CRC CARE involves a contribution to national policy directions set by government. Along with Technical Reports, the Contaminated Sites Law & Policy Directory provides a means for the CRC to disseminate information about the legal framework surrounding the complex issue of contaminated sites. Targeting legal advisors, policymakers, industries and academics, the information provided is the result of comprehensive analysis of the regulatory processes and responsibility allocation relating to contaminated sites. The summaries, which are reviewed annually for currency, provide the reader with a clear understanding of the legislation, guidelines and other documentation, and government policies that shape the approaches taken by authorities in addressing the issue of contaminated site management. In 2013/14 a decision was made to commission a major update of the directory; this process continued in 2014/15.

The CRC implemented a communication strategy as part of its development of a National Remediation Framework (see page 10). This involved email campaigns, a press release and promotion via social media to invite members of the public to provide feedback on draft guidance documents, which were made available for download via the CRC website.

3.3.5 INTERNAL COMMUNICATION

CRC CARE places a high degree of importance on effective internal communications among its nodes across five Australian states and China. The main vehicle for communicating with these groups is the CRC's electronic newsletter, *Remediator*, launched in June 2014. This publication provides an easy-to-read digest of news and events, reaches a large audience (subscribers include interested non-CRC industry and research personnel), drives traffic to the CRC website and social media platforms, and provides analytics that can be used to improve the product. The email campaign functionality also allows tailored alerts to be sent to very specific researchers (e.g. researchers in a particular state or PhD students only).

Five issues of Remediator were published in 2014/15:

ISSUE NO.	DATE	# RECIPIENTS	# UNIQUE OPENED	# UNIQUE CLICKS
2	29 August	3542	771 (28%)	204
3	07 Nov	3464	813 (30%)	260
4	16 Dec	3451	711 (26%)	207
5	04 Mar	3423	688 (26%)	325
6	29 June	2830	717 (29%)	136

The lower number of recipients for issue 6 was a result of deleting obsolete email addresses from the subscription list.

The CRC also holds a biennial gathering of all staff (known as the 'Communicate' conference series) to present research, including PhD projects, and build relationships. Communicate 2014 was held in September, with around 100 researchers, students and other Participant representatives converging on CRC CARE headquarters at UniSA Mawson Lakes. An equivalent – the 'Commun Workshop' – is held in China for CRC CARE-sponsored PhD students there, and is attended by senior staff from Australia. See page 22, *Education and training*, for more details.

04 RESOURCES

4.1. Governance – board, committees and key staff

4.1.1. COMPANY STRUCTURE

CRC CARE Pty Ltd (the Company) is an incorporated venture established on 13 September 2005 to carry out the activities of CRC CARE. The Company is a limited liability entity with 14 shareholders. Voting and dividend rights are determined by the value of contributions by shareholders ('Core' Participants) in the relevant financial year. Voting rights and the payment of returns from any commercialisation of IP for 'Supporting' (non-shareholder) Participants of CRC CARE are provided for through the ownership of shares in projects.

The Company is governed by a shareholder-elected skills-based board. The maximum number of directors is 10, with the majority of members required to be independent of the shareholders, and with a further and more specific requirement for the Chairperson to be independent of Participants (Core and Supporting) as well as the management of CRC CARE and CRC CARE Pty Ltd. In 2014/15 the CRC's Board had nine directors.

The Chairperson is elected at each AGM with the balance of Directors serving a term of two years, after which they are eligible to seek another term. During 2014/15 the Board met six times. Ms Beth Laughton did not offer herself for re-election at the AGM and Ms Bronwyn Constance was elected to fill the position.

4.1.2. THE CRC CARE BOARD

The following table presents details of the members of the CRC CARE Board in 2014/15:

NAME	ROLE	KEY SKILLS	INDEPENDENT/ ORGANISATION
Elected Members of the Board from 1 July 2014			
Dr Peter Jonson	Independent Chair of Board, Remuneration and Succession Committee, Beyond 2020 Committee	CRCs, industry, commercial and management	Independent
Prof. Ravi Naidu	Chief Executive Officer and Managing Director, Research and Technology Committee, Audit and Risk Management Committee, Remuneration and Succession Committee, Policy Advisory Committee, Management Committee, Beyond 2020 Committee	Research, management, commercial, policy and end-user linkages	CRC CARE
Adjunct Prof. Don Sinnott	Board Director, Research and Technology Committee (Chair)	Research and policy	Independent
Dr Rod Lukatelich	Board Director, Research and Technology Committee, Remuneration and Succession Committee (Chair), Policy Advisory Committee	Petroleum industry, research, environmental management	BP Refinery Kwinana Pty Ltd
Dr Paul Vogel	Board Director, Research and Technology Committee, Policy Advisory Committee	Regulatory	Independent
Ms Anthea Tinney	Board Director, Audit and Risk Management Committee, Remuneration and Succession Committee, Policy Advisory Committee (Chair)	Regulatory, policy and governance	Independent
Mr Charles Wong	Board Director, Audit and Risk Management Committee	Venture capital/finance	HLM Asia Group Ltd
Dr Stephen Rodda	Board Director, Audit and Risk Management Committee, Remuneration and Succession Committee	Research, academic and management	UniSA
Ms Beth Laughton^	Board Director, Audit and Risk Management Committee (Chair)	Accounting and finance	Independent
MEMBERS OF THE BOARD FROM 2 DECEMBER 2014 TO 30 JUNE 2015			
Ms Bronwyn Constance	Board Director, Audit and Risk Management Committee (Chair)	Accounting and finance	Independent
COMPANY SECRETARY			
Ms Cathy Cooper	Audit and Risk Management Committee	Legal	Independent

^ Beth Laughton retired as Director at the AGM on 2 December 2014 and did not stand for re-election.

The Board's roles include:

- appointing the Chief Executive Officer (CEO) and Managing Director
- providing strategic direction to the Company
- overseeing the financial management of the Company
- ensuring that effective governance practices are in place, including an integrated and detailed approach to risk management
- monitoring senior management performance
- developing succession plans
- ensuring that the Company adheres to a high ethical standard.

The Board provides the overall strategic direction necessary to ensure that the above roles are carried out, and exercises stewardship of the Company's resources in a manner that enables its objectives to be met.

Where particular agreements apply (e.g. the Commonwealth Agreement and the Participants' Agreement), the Board will use its best endeavours to ensure that the objectives, policies, strategies and plans applicable to the Company are met.

In 2014/15, Board meetings were held in August, October, December, March, May and June. Attendances were as follows:

	NUMBER OF MEETINGS ELIGIBLE TO ATTEND	NUMBER OF MEETINGS ATTENDED
Dr Peter Jonson	6	6
Prof. Ravi Naidu	6	6
Dr Stephen Rodda	6	5
Dr Rod Lukatelich	6	6
Dr Paul Vogel	6	5
Mr Charles Wong	6	4
Ms Anthea Tinney	6	5
Ms Beth Laughton^	3	2
Ms Bronwyn Constance^^	3	3
Adjunct Prof. Don Sinnott	6	4

^ Beth Laughton retired from the Board in December 2014.
^^ Bronwyn Constance was elected to the Board in December 2014.

4.1.3. BOARD PROFILES

DR PETER JONSON

Peter Jonson was elected to the position of Chairman of CRC CARE at the AGM of shareholders in November 2013. Dr Jonson worked as an economist at the Reserve Bank of Australia from 1972 to 1988, where he was appointed Head of Research – the RBA's Chief Economist – in 1981. During this time his principal task was advising the Board of the Bank on economic prospects and the appropriate setting of monetary policy. Peter's second career was as CEO of two substantial private financial service companies from 1989 to 1999 – Norwich Union and ANZ Funds Management. Since 1999, Dr Jonson has worked as a professional company director. He is a previous lead independent director of Village Roadshow Ltd and has served on the boards of several innovative companies in the biotech and defence sectors. Peter Jonson was Chair of the CRC Committee from 2005 to 2010, during a time of review and reform of the program. He was the founding Chair of the Australian Institute for Commercialisation and the Interim Chair of the Innovative Manufacturing CRC.

PROFESSOR RAVI NAIDU

MANAGING DIRECTOR BSC, MSC, PHD, FSSSA, FASA, FNZSSS, FAAS, CCHEM

Ravi Naidu has been a research leader in environmental contaminants, bioavailability and remediation for over 30 years. He is co-author of more than 500 technical publications and co-editor of 10 books in the field of environmental science including field remediation of contaminated sites. He was the initiator and inaugural director of the Centre for Environmental Risk Assessment and Remediation where he conceived, developed and led the successful bid for CRC CARE in 2004. He also led the successful bid for CRC CARE's nine-year extension in 2010. Prior to joining UniSA in December 2002, Prof. Naidu was Chief Research Scientist and Leader of the Remediation of Contaminated Environments Program at CSIRO Land and Water Division, and Component Coordinator of CSIRO's Land and Water Sector.

Prof. Naidu was awarded a Gold Medal in environmental science in 1998 by Tamil Nadu Agricultural University, has been awarded the status of Chartered Chemist, and is a Fellow of the Soil Science Society America (elected in 2000), the Soil Science Society of New Zealand (2004), the American Society of Agronomy (2006) and the American Association for the Advancement of Science (2012). He is Chair of the International Committee on Bioavailability and Risk Assessment and a sitting member of the EPA Victoria Contaminated Sites Auditor Panel. He has also been Chair of the Standards Australia Technical Committee on Sampling and Analyses of Contaminated Soils (1999–2000), Chair of the International Union of Soil Sciences Commission for Soil Degradation Control, Remediation and Reclamation (2002–10), and President of the International Society on Trace Element Biogeochemistry (2005–07).

MS BRONWYN CONSTANCE

FAICD, FACPA, FCIS

Bronwyn Constance has a strong industrial and financial background with extensive corporate experience at senior management level in Australia and overseas. The early part of her career was spent with the ACI Group of companies, followed by senior financial roles with Kraft Foods Ltd in Australia and Asia, as chief financial officer of Pasminco Ltd, and as Finance Director of Nylex Ltd. Since retiring from full-time executive roles, Ms Constance has been a non-executive director on public and private company boards. Currently she is a director and chairs the audit committees of Defence Materials Technology Centre Ltd and Rail Manufacturing CRC Ltd. Ms Constance is a Fellow of the Australian Institute of Company Directors, a Fellow of the Australian Society of Certified Practicing Accountants, and a Fellow of the Chartered Institute of Secretaries.

MS BETH LAUGHTON

BEC, FCA, FAICD

Beth Laughton graduated with a Bachelor of Economics from the Australian National University in 1979. After qualifying as a Chartered Accountant with Peat Marwick Mitchell (KPMG), she spent more than 20 years in investment banking, providing advice to companies on mergers, acquisitions, divestments and equity capital market transactions. She is currently a non-executive director of JB Hi-Fi Limited and Chair of its Audit and Risk Management Committee, and a non-executive director of the Australand Property Group entities and a member of their Audit Committee. She is a member of the Defence SA Advisory Board and Audit and Risk Management Committee.

DR ROD LUKATELICH
BSC (HONS), PHD, MAIBIOL

Rod Lukatelich's career has spanned academia, environmental consulting and industrial environmental management. As a lecturer/research officer (1982–89) at the Centre for Water Research at the University of Western Australia his research included studies on the impacts of eutrophication on algae and seagrasses in lakes and estuaries; development of ecological models; and the relationships between hydrodynamics and water quality in reservoirs, rivers and estuaries. In 1989 Dr Lukatelich joined Kinhill Engineers as Senior Aquatic Ecologist and in 1990 joined BP Refinery Kwinana as Environmental Manager. In various roles at BP he led a team of environmental engineers and was responsible for environmental management systems, monitoring and reporting emissions, wastewater treatment, environmental impact assessment for major projects, solid waste management, groundwater production, soil and groundwater remediation, dangerous goods management, and Major Hazardous Facility Safety Reports. He has also supported BP's global refining businesses as a Senior Environmental Technologist (1995–97) and as Water Technology Advisor (2004–06) in the areas of contaminated site assessment and remediation, and wastewater treatment, respectively.

Dr Lukatelich has broad experience in regulatory systems, having completed major contaminated site remediation projects in Asia, Europe and the Americas and the Middle East. He retired from BP in 2014 and now works part time as an environmental consultant. He has published more than 50 refereed papers and book chapters in environmental science. He has been a Board Director of CRC CARE Pty Ltd since its inception; is a member of CSIRO's Energy Strategic Advisory Committee; Chairs the Great Australian Bight Research Program Management Committee, and was a member of the Environmental Protection Authority of Western Australia (2009–14).

DR STEPHEN RODDA

Stephen Rodda is CEO of ITEK Ventures Pty Ltd (UniSA's technology commercialisation company). He has a combined 15 years of experience in the areas of scientific research, research management, technology commercialisation, investment management and corporate governance. Dr Rodda has a successful track record in attracting grant funding and publishing in peer-reviewed journals, and has personally generated patentable innovations for commercialisation. He has been involved in technology commercialisation at every stage of the commercialisation process from the implementation of technology development and IP strategies through to capital raisings. He has also performed executive management roles in early-stage companies. Throughout his career, Dr Rodda has played an active role in the formation and financing of more than 10 companies and in securing approximately $50 million in grants, investments and other funding.

Dr Rodda was educated at the University of Adelaide, gaining a PhD in Biochemistry. Subsequently he was awarded CJ Martin and Arthritis Foundation support as a Fellow at Harvard University. In addition, he holds a Masters of Business Administration from La Trobe University, is a Graduate of the Australian Institute of Company Directors and has recently undertaken the Advanced Management Program at the Harvard Business School.

ADJUNCT PROFESSOR DON SINNOTT
PHD, LFIEEE, FIEAUST, CPENG(RET)

Don Sinnott is an independent electronic systems consultant. He has been an Adjunct Professor with Adelaide University (2000-14) and was CEO of the CRC for Sensor Signal and Information Processing and Company Board Chairman of that CRC's spin-off companies (2000-03). Prior to that he was chief of a number of research divisions in sensing and information technology (IT) disciplines within Australia's Defence Science and Technology Organisation (1987-2000) and the Department of Defence's Canberra-based First Assistant Secretary Science Policy (1995-97). He played a major role in development of Australia's Jindalee over-the-horizon radar system and has chaired a number of academic and government technology policy committees and boards. Prof. Sinnott has extensive professional research and development experience in applied electromagnetics, including radio and radar systems, antennas and radio propagation, signal processing, and global navigation satellite systems (GPS and related systems). He joined the Board in March 2013.

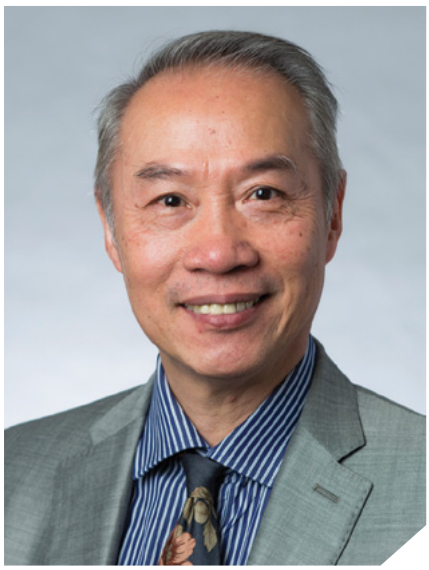
MS ANTHEA TINNEY

Anthea Tinney is the immediate past Chair of the Sydney Harbour Federation Trust and Chair and/or independent member of a number of public sector audit committees. She was previously Chair of the Australian National Commission for the United Nations Educational, Scientific and Cultural Organization (UNESCO), Chair of Land and Water Australia, a member of the Australian Government's Independent Communications Committee, and the inaugural independent Chair of the Steel Stewardship Forum.

Ms Tinney was a deputy secretary in the federal environment portfolio and, prior to leaving the Australian Public Service in 2008, was appointed as the Interim CEO of the National Film and Sound Archive. Her public service career also included a period as the head of the Cabinet Office in the Department of Prime Minister and Cabinet and some years in the Treasury. Ms Tinney has served on several boards and has wide experience in government administration and advising on public policy. She has a Bachelor of Economics degree and was awarded a Public Service Medal in 1995 for services to the Australian Cabinet system.

DR PAUL VOGEL
CHAIRMAN, EPA WA

Paul Vogel has a PhD in chemistry from the University of Western Australia. He is Chairman of the EPA WA, the primary source of independent advice to the WA Government on the environmental acceptability of all significant development proposals and on important environmental issues. Previously he was the inaugural Chief Executive and Chairman of the EPA SA, with responsibilities for environmental regulation, development assessment and radiation protection. Dr Vogel has worked across the three tiers of government, business and the community, and has extensive experience and knowledge in organisational and regulatory reform and strategic and collaborative approaches to sustainability, natural resources management, waste management, air and marine quality, site contamination, and radiation protection.



MR CHARLES WONG

Charles Wong is a professional engineer who worked in the telecommunications industry in Canada for over 25 years until his move in late 2005 to work as a project manager at HLM Asia Group Ltd Hong Kong, a financial consulting and investment firm with offices in Hong Kong and Beijing. His responsibilities in the telecommunications industry included research and development, manufacturing, marketing and product management for a multinational telecommunication company. He has a BASc from the University of Toronto. Mr Wong's main focus with HLM Asia Group includes corporate financing, mergers and acquisitions, investment fundraising, and initial public offerings. HLM has significant involvement in traditional and renewable energy businesses in the People's Republic of China. Mr Wong is currently overseeing CRC CARE's research activities in China.

4.1.4. BOARD COMMITTEES

The CRC CARE Board has a number of subcommittees to oversee aspects of the Company's strategic planning and decision making. Chaired by directors from the Board, the following committees have been delegated powers as detailed below:

- Audit and Risk Management Committee
- Remuneration and Succession Committee
- Research and Technology Committee.

AUDIT AND RISK MANAGEMENT COMMITTEE

The primary purpose of the Committee is to assist the Board in fulfilling its responsibilities relating to the financial reporting and risk management practices of the Company.

In particular, the Committee will:

- oversee, coordinate and appraise the quality of the external audit, and recommend appointment, and the terms of such appointment, of the external auditor to the Company
- maintain, through regular meetings, open lines of communication between the Board and the external auditors to exchange views and information as well as to confirm their respective authority and responsibilities
- serve as an independent and objective party to review the financial information submitted by management to the Board for issue to members and regulatory authorities
- oversee compliance with the Commonwealth and Participant Agreements and the requirements of the Corporations Act as they apply to the operations of the Company
- review the adequacy of the reporting and accounting controls
- review the Company's overall risk profile to ensure that material risks are dealt with appropriately, including in conjunction with other Board committees where required
- oversee the development and maintenance of policies and practices to identify, assess, monitor and report risk.

The Audit and Risk Management Committee meets at least three times a year.

COMMITTEE NAME	AUDIT AND RISK MANAGEMENT COMMITTEE	
FROM 1 JULY 2013 TO 30 JUNE 2014		
Name	Role	Independent/organisation
Ms Beth Laughton^	Chair	Independent
Ms Bronwyn Constance^^	Chair	Independent
Dr Stephen Rodda	Member	UniSA
Ms Anthea Tinney	Member	Independent
Mr Charles Wong	Member	HLM Asia Group Ltd
Ms Cathy Cooper	Company Secretary	

^ Beth Laughton retired from the Board in December 2014.
^^ Bronwyn Constance was elected to the Board in December 2014.

REMUNERATION AND SUCCESSION COMMITTEE

The Committee:

- ensures that levels of remuneration are sufficient to attract and retain executives of the quality required to successfully manage the Company
- ensures that 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
- reviews and recommends to the Board remuneration policies and packages for the Managing Director and senior executives directly reporting to the Managing Director so as to link remuneration to corporate and individual performance
- recommends to the Board any changes in remuneration policy including superannuation, and remuneration structure for executives identified above
- ensures there is a proper performance-management process in place throughout the organisation and that it is operating effectively
- reviews and recommends to the Board any changes to non-executive directors' fees.

The Remuneration Committee comprises four Company directors (including the Board Chair) and during 2014/15 was chaired by Dr Rod Lukatelich. The Committee meets as often as is required by the Board or as the Committee may determine, but generally not less than once a year.

COMMITTEE NAME	REMUNERATION AND SUCCESSION COMMITTEE	
FROM 1 JULY 2013 TO 30 JUNE 2014		
Name	Role	Independent/organisation
Dr Rod Lukatelich	Chair	BP Refinery Kwinana Pty Ltd
Dr Stephen Rodda	Member	UniSA
Ms Anthea Tinney	Member	Independent
Mr Russell Caplan	Member	Independent
Dr Peter Jonson	Member	Independent

RESEARCH AND TECHNOLOGY COMMITTEE

The purpose of the Committee is to provide:

- oversight of the research activities of the Company
- advice to the Board and Managing Director on strategic issues and individual projects
- advice on any other matters referred to the Committee by the Board.

The Research and Technology Committee meets at least twice a year.

COMMITTEE NAME	RESEARCH AND TECHNOLOGY COMMITTEE	
Name	Role	Independent/organisation
Adjunct Prof. Don Sinnott	Chair	Independent
Dr Rod Lukatelich	Member	BP Refinery Kwinana Pty Ltd
Prof. Ravi Naidu	Member	CRC CARE
Dr Paul Vogel	Member	EPA WA
Mr Andrew Pruszinski (policy)	Member	EPA SA
Mr Stuart Rhodes (minerals industry)	Member	Rio Tinto
Mr Andrew Kohlrusch (consultancy/ environmental practitioner)	Member	ACLCA
Prof. Ming Wong (research)	Member	Hong Kong Institute of Education
Prof. Gary Pierzynski (research)	Member	Kansas State University USA
Prof.Brent Clothier (research)	Member	Plant & Food Research NZ

BEYOND 2020 COMMITTEE

The Beyond 2020 Committee provided advice to the Board on CRC CARE post mid-2020, when its Commonwealth funding ceases. Through to late 2014, the Committee had three main objectives:

- To enable the Board to satisfy the Commonwealth Department of Industry's condition of funding that by the end of 2014 CRC CARE produce a business plan for review and approval by the Board that outlines the options available for the transition post Commonwealth funding. The preparation of the business plan allows for a considered review of the current activities of CRC CARE as an input into the business planning process. This plan was completed to schedule.
- To take the opportunity to engage existing Participants in a dialogue on a broad range of issues including the vision for CRC CARE post 2020, the scope of its activities, the embrace of its membership, the value propositions for Participants, and the likely requirements to operate; also, at a suitable time during this engagement, to begin a dialogue with potential new Participants.
- To use the discussions and other activities through to late 2014 and the (preliminary) business plan itself as the launching pad for further work from 2015 to 2017, which will result in a final, detailed business plan that includes firm commitments of support from intending Participants in CRC CARE post 2020.

Having delivered the business plan, the committee was wound up in late 2014.

COMMITTEE NAME	BEYOND 2020 COMMITTEE	
Name	Role	Independent/organisation
Emeritus Prof. Max Brennan	Chair	Independent
Paul Barrett	Deputy Chair	Australian Institute of Petroleum
Prof. Ravi Naidu	Member	CRC CARE
Jason Borg	Member	EPA Vic
Campbell Gemmell	Member	EPA SA
Richard Head	Member	UniSA
Mike Healy	Member	Department of Defence
Bruce Kelley	Member	Independent – Minerals Industry
Peter Nadebaum	Member	GHD
Gavin Price	Member	BHP Billiton Iron Ore
Charles Wong	Member	HLM Asia Group Ltd

4.1.5. NON-BOARD COMMITTEES

The Policy Advisory Committee and Management Committee are non-Board committees that report to the Managing Director.

POLICY ADVISORY COMMITTEE

The purpose of the Committee is to advise the Managing Director on:

- environmental policy matters, including those matters referred to it by the Managing Director or the Board
- policy projects and/or the policy implications of projects undertaken by CRC CARE
- the path to adoption for policy projects and policy acceptance for the outcome of other projects
- new directions for research as well as on technical matters and technologies, from a public policy perspective, as they relate to CRC CARE's research directions
- any other matters referred to the Committee by the Managing Director or the Board.

The Committee provides its advice on a 'best endeavours' basis taking into account the resources available to the Committee (noting that such advice cannot be binding on any Commonwealth, State or Territory regulatory agency or local government authority concerned with land management and/or site assessment and remediation).

The Committee is a resource for sharing policy experience on site contamination assessment, remediation and management issues among its members and other stakeholders.

The Policy Advisory Committee meets not less than twice per year.

COMMITTEE NAME	POLICY ADVISORY COMMITTEE	
Name	Role	Independent/organisation
Ms Anthea Tinney	Chair	Independent
Dr Rod Lukatelich	Member	BP Refinery Kwinana Pty Ltd
Dr Paul Vogel	Member	Independent
Prof. Ravi Naidu	Member	CRC CARE
Dr Janet Macmillan (regulatory agency)	Member	WA DER
Mr Niall Johnston (regulatory agency)	Member	Independent
Mr Stuart Rhodes (mining industry experience)	Member	Rio Tinto
Mr Ross McFarland (site auditing experience)	Member	AECOM
Dr Bruce Kennedy (Program 1 leader; regulatory experience)	Member	CRC CARE
Mr Andrew Pruszinski (policy)	Member	EPA SA
Ms Mitzi Bolton (policy)	Member	EPA VIC

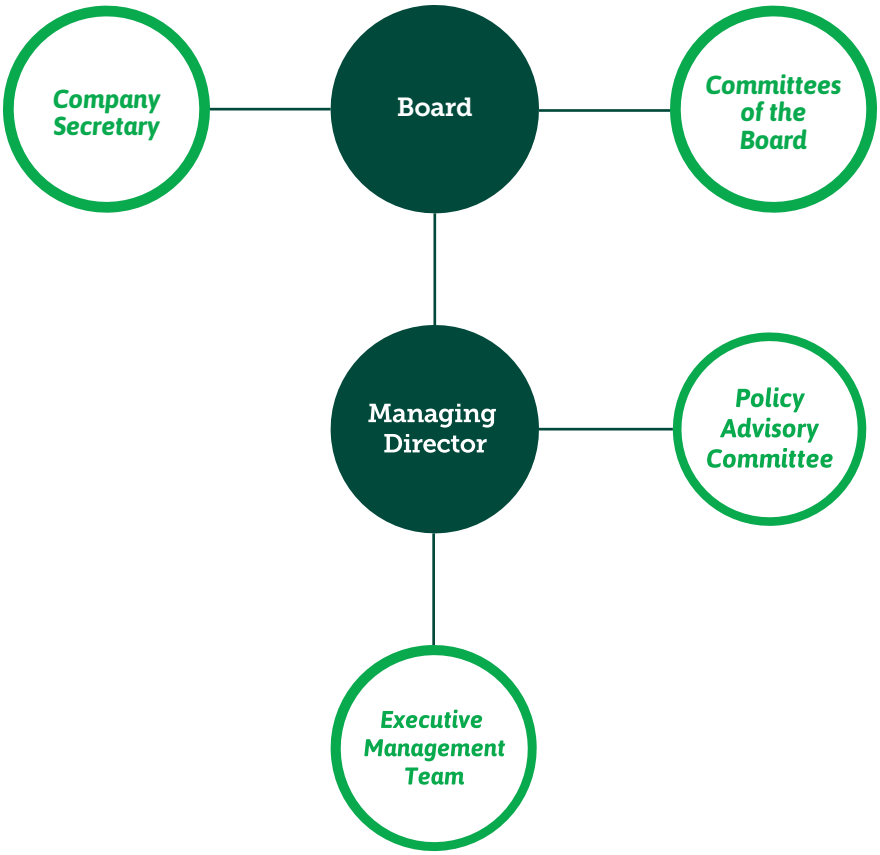
4.1.6. CRC CARE STAFF

Key CRC CARE staff during 2014/15 are detailed in the table below.

KEY STAFF		
Name	Organisation	CRC CARE position/role
Prof. Ravi Naidu^	CRC CARE	CEO, Managing Director and Chief Scientist
Mr Michy Kris	CRC CARE	Business Manager
Mr Kevin Weidenhofer	CRC CARE	Finance Manager
Dr Bruce Kennedy	CRC CARE	Program 1 Leader
Dr Cheryl Lim	NMI	Program 2 Leader
Prof. Jack Ng	UQ	Program 3 Leader
Prof. Megharaj Mallavarapu	UniSA	Program 4 Leader
Prof. Nanthi Bolan	UniSA	Program 5 Leader
Mr Andrew Beveridge	CRC CARE	Education Program Leader
Mr Adam Barclay	CRC CARE	Communication Manager

^ 0.2 EFT Director of the Global Centre for Environmental Remediation (University of Newcastle).

4.1.7. Organisational structure



4.2. Participants

During the 2014/15 reporting period, one new Participant, the University of Newcastle, was listed in the Commonwealth Agreement, bringing the total number to 28.

The Participant list as at 30 June 2015 is as follows:

PARTICIPANT	PARTICIPANT TYPE	AUSTRALIAN BUSINESS NUMBER	ORGANISATION TYPE (OR INDIVIDUAL)
Agilent Technologies Australia Pty Ltd	Supporting	29 088 510 605	Industry/private sector
Australian Contaminated Land Consultants Association Incorporated	Supporting	n/a	Consulting industry association
Australian Institute of Petroleum Ltd	Core	11 005 152 581	Industry/private sector
BHP Billiton Iron Ore Pty Ltd	Supporting	46 008 700 981	Industry/private sector
CH2M HILL Australia Pty Limited	Supporting	42 050 070 892	Industry/private sector
ChemCentre (WA)	Supporting	40 991 885 705	Industry/private sector
Chevron Australia Pty Ltd	Core	29 086 197 757	Industry/private sector
CSIRO	Supporting	41 687 119 230	Australian Government
Curtin University	Supporting	99 143 842 569	University
Department of Defence	Core	68 706 814 312	Australian Government
Department of Environment and Resource Management (Queensland)	Supporting	46 640 294 485	State government
Department of Industry, Innovation and Science – National Measurement Institute	Supporting	74 599 608 295	Australian Government
EPA SA	Core	85 393 411 003	State government
EPA Victoria	Supporting	85 899 617 894	State government
EthicalChem^	Core	International	Industry/private sector
FibreCell Australia Pty Ltd	Supporting	60 114 025 759	Industry/private sector
GHD Pty Ltd	Core	39 008 488 373	Industry/private sector
HLM Asia Group Limited	Core	International	Industry/private sector
JBS&G Pty Ltd	Core	62 100 220 479	Industry/private sector
Royal Melbourne Institute of Technology (RMIT)	Core	49 781 030 034	University
Southern Cross University	Core	41 995 651 524	University
Technological Resources Pty Ltd (Rio Tinto)	Supporting	12 002 183 557	Industry/private sector
University of Newcastle	Core	15 736 576 735	University
University of Queensland	Core	63 942 912 684	University
University of South Australia	Core	37 191 313 308	University
University of Technology, Sydney	Core	77 257 686 961	University
University of Western Sydney	Core	53 014 069 881	University
WA Department of Environment Regulation	Supporting	98 954 078 362	State government

^ Formerly VeruTEK Technologies, Inc., which became EthicalChem after being acquired by Ethical Solutions, LLC.

4.3. Collaboration

In addition to SME engagement, CRC CARE has built strong collaborations in all aspects of its research program, from proposal development through to advisory panel assessment, research, demonstration sites, and industry training programs. CRC CARE's research and demonstration nodes are distributed widely across Australia, with hubs in NSW, SA, WA, Victoria and Queensland. Internationally it has established collaborations in Bangladesh, China, Germany, Korea, Netherlands, Singapore, Spain, Taiwan, UK and USA.

Significant collaborations are undertaken through the NCSDP with CRC CARE's partners DoD, BHPBIO and AIP (see pages 16–19 for further details). Dedicated CRC CARE coordinators manage the projects associated with these organisations, drawing on universities, consultants, SMEs and end users to deliver research objectives. The unique structure of the demonstration program is mutually beneficial for researchers and industry alike – industry partners are able to investigate and assess potential clean-up options for their sites, while CRC CARE researchers are able to fast-track the application of science to the field by working directly with industry in contaminated environments to test scientific ideas and technology.

INTERNATIONAL LINKS

CRC CARE researchers continue to collaborate extensively with international scientists, leading research and development on contamination assessment and remediation. Part of this involves extensive work in China via our China Program (see page 20). This collaboration includes work with overseas researchers based in their home countries as well as numerous visiting scientists, who spend three to six months with CRC CARE researchers in Australia. The increasing number of visiting scientists is evidence of the global recognition that CRC CARE has established.

In addition to direct project work, three internationally renowned industry representatives act as committee members of the CRC's Research and Technology Committee – Dr Brent Clothier (Plant and Food Research, New Zealand), Prof. Gary Pierzynski (Kansas State University, USA) and Prof. Ming H. Wong (Hong Kong Institute of Education). Other international collaborations established through the CRC, and which continued into the 2014/15 financial year, are outlined below.

Bangladesh

The CRC has linked with Dhaka University to investigate arsenic contamination in drinking water and the local food supply. An estimated 35 million people are exposed to water with an arsenic concentration above 50 micrograms per litre in Bangladesh, and a further 4.2 million people are exposed in West Bengal, India. Many people in these two regions suffer from arsenic-related diseases. Journal papers based on the work continue to be published.

China

CRC CARE continues to further build and strengthen collaboration with Prof. Xiao Bo (HUST) and Prof. Lena Ma (Nanjing University). Prof. Ma will be hosting the 8th International Workshop on Chemical Bioavailability, which was initiated by Prof. Naidu in 2000. Research on bioavailability of contaminants continues. The CRC supports a number of PhD scholarships at HUST and CRC CARE staff (including the Managing Director) and Board Member Mr Charles Wong visited HUST in May 2015 for the annual 'Commune' event, which helps build the capacity of students to communicate their science in English.

Germany

Active collaboration continues with the German research agency RUBIN and remediation experts Mull and Partners gmbh in the deployment of permeable reactive barrier technology for the treatment of groundwater contaminated with chlorinated hydrocarbons and heavy metals. Prof. Volker Birke, at Ostfalia University of Applied Sciences, has been actively involved with CRC CARE since 2008 and contributes his expertise to a number of DoD projects.

Japan

Program 3 Leader Prof. Jack Ng is continuing his work with Prof. Tetsuya Suzuki from the Graduate School for the Creation of new Photonics Industries on utilising Euglena species as a model single-celled *in vivo* organism for developing a unicellular cell tool for the toxicity assessment of metals and metalloids (pure or mixtures) – the 'cell-on-a-chip' concept.

Korea

Extensive collaboration is occurring with Prof. Yong Sik Ok (Kangwon National University) and Dr Kwon Rae-Kim (Gyeongnam National University of Science and Technology) on synchrotron-based studies.

Netherlands

Collaboration on bioavailability continues with Dr Joop Harmsen from the Alterra research institute at Wageningen University and Research Centre. In 2014/15, this work led to a joint European COST (Cooperation in Science and Technology) Action proposal involving more than 12 scientists.

Singapore

CRC CARE researchers and the National University of Singapore continue to work together on nanomaterials, including the characterisation of clays and synthetic materials potentially used for wastewater and soil remediation.

Spain

Collaboration on bioavailability continues with Prof.José-Julio Ortega-Calvo from the Spanish National Research Council.

Taiwan

Collaboration on soil and groundwater remediation has been undertaken with Prof. Zueng-Sang Chen from National Taiwan University. Prof. Chen is also leading an Asian soil and groundwater research cluster, which involves collaboration with CRC CARE.

UK

CRC CARE continues to work with Cranfield University on risk communication activities, in particular with risk management expert Prof. Simon Pollard. Prof. Naidu continued his collaboration with Prof. Paul Nathaniel (University of Nottingham and Land Quality Management Ltd), Dr Mark Cave (British Geological Survey) and Prof. Kirk Semple (Lancaster University) on bioavailability and risk assessment.

USA

USA company EthicalChem (formerly VeruTEK) continues to be involved in the CRC's research into the use of chemical oxidation techniques for groundwater remediation, in conjunction with the Australian DoD. The CRC works closely on training on DNAPL contamination with the Interstate Technology & Regulatory Council (ITRC), a public-private coalition working to reduce barriers to the use of innovative environmental technologies that reduce compliance costs and maximise clean-up efficacy. Through ITRC's Integrated DNAPL Site Strategy Team Lead, Naji Akladiss, collaboration has also been established with the Maine Department of Environmental Protection, where Mr Akladiss is a NAPL site project manager.

4.4. Financial management

CRC CARE depends on the continued support from its Participants and the Commonwealth Government for its ongoing operations. During the 2014/15 financial year, 59% of CRC CARE's cash contributions were sourced from Participants and 41% from the Commonwealth. Cash contributions received from the Commonwealth exceeded their agreed requirement due to the bringing forward of contributions from 2016/17 to 2014/15 to enable CRC CARE to address operating losses and negative cash flows experienced in 2014/15.

The overall financial performance of CRC CARE for the year was below expectations, with the Company experiencing substantial operating losses and negative cash flows during the financial year. This is attributed to a large extent to the relocation of CRC CARE from Adelaide to Newcastle. The continuing financial sustainability of CRC CARE and its ability to support existing and any new projects are dependent on the Company being successful in:

i. receiving the continuing support of the Participants and the Commonwealth of Australia

ii. negotiating additional funding

iii. 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 independent auditor's report to the members of CRC CARE for the financial year 2014/15 has expressed the opinion that the financial report of CRC CARE has been prepared in accordance with the Corporations Act 2001. Their opinion further states that the financial report as at 30 June 2015 gives a true and fair view of the Company's financial position as at that date and of its performance for the year ended on that date, and complies with Australian Accounting Standards.

05 OTHER ACTIVITIES

5.1. Other activities

In 2014/15 CRC CARE received no additional financial assistance or grants.

The CRC makes a small number of online sales, and is continuing to build its library of publications and videos. Purchases from the online shop totalled $543 during the financial year. Items sold included:

- Recordings (audio plus slideshow) of the seminar and webinar series
- *Engaging the community: a handbook for professionals managing contaminated land.*

MEMORANDA OF UNDERSTANDING

CRC CARE has two memoranda of understanding, both with international universities, in place since 2009 and 2010 respectively (see below).

India

In 2009, CRC CARE and the Indian Institute of Technology, Kanpur (IITK) signed a memorandum of understanding to work together on research projects and the training of experts in contamination risk assessment and clean-up. IITK ranks as one of India's premier research institutes and is known worldwide for its technological and engineering expertise. The agreement also offers opportunities for Australian companies specialising in clean-up technologies to take advantage of the rapid growth of the Indian market.

A second agreement is also operational with Bharatiar University, India. This targets collaboration in the development of novel nanomaterials for remediation. The agreement provides for the exchange of both staff and students. Strong links with Tamil Nadu Agricultural University have also enabled a continuing flow of high-quality graduates taking up PhD scholarships with CRC CARE at UniSA.

South Korea

In February 2010, a memorandum of understanding was signed between CRC CARE and HUNIC, the Hub University of Industrial Collaboration, based at the Gyeongnam National University of Science and Technology in Korea (previously the Jinju National University). This collaboration, based on green technologies, has resulted in the exchange of information, staff and students during the financial year. Through the memorandum of understanding, UniSA researchers assisted on a HUNIC-funded project on biochar and metal dynamics. This collaboration has significantly advanced the training and capacity building around green approaches to contaminant containment and remediation.

06
ADDITIONAL REQUIREMENTS

Following the extension of CRC CARE into a second term of funding, it is now considered a round-13 CRC. CRC CARE underwent its first-year review in March 2013. All recommendations from that review have been implemented.

Overall, the CRC Committee was very pleased with the progress of CRC CARE in its second term. As a result of this, the CRC Committee recommended that CRC CARE's first independent performance review should be moved to early 2015 and that the Commonwealth Agreement should be varied to accommodate this change. The performance review took place in May 2015. As such, few of the recommendations had been fully implemented by the end of the reporting period (although some were already being addressed prior to the review). In view of this timeframe, we have omitted the 'Implemented (Y/N)' and 'Reasons why not implemented' columns from the below table.

PERFORMANCE REVIEW RECOMMENDATIONS

Recommendation	Strategies to implement
1. *The CRC develop a clearly defined succession plan that provides a framework aligning leadership and strategic management skills and experience with the strategic needs of the CRC from now through to 2020 and beyond. Particularly in relation to the CEO, the plan should include analysis of the job requirements (business management, research, key relationships and advocacy) and the opportunity to adjust the role/ duties of the CEO in light of changing conditions and strategic imperatives. The plan should also include a succession framework for other key personnel including research program leaders.*	The Board agrees that it is necessary to regularly review the duties and skills of the management team to ensure it is adequately resourced and has the competencies required to meet the evolving needs of the organisation. The recommendation will ensure that we bring more strategic focus to these reviews. The Chair and the Board have already identified some key individuals who may be able to replace the CEO if required. As regards Program Leaders, each Program has a Deputy Leader who could step into Program Leadership if needed. Business Manager and Finance Manager support is also being provided by the University of Newcastle. We will continue to work on this matter, including with UON.
2. *The CRC strengthen governance arrangements to ensure that the board is able to drive the organisation forward, given the changes that will occur. The CRC should explore opportunities for inclusion of member/s with pollution and remediation process and technology commercialisation skills in the composition of the board*	The Board has several current members (Sinnott, Rodda, Jonson) with experience in commercialisation of research outcomes in fields other than pollution and remediation process and technology. Within the size and resource constraints of an independent, skills-based board, we will explore opportunities for augmenting the Board's skills base as recommended.
3. *The CRC actively explore and act on opportunities that the move to the University of Newcastle presents. In particular, opportunities relating to gaining assistance from the university for some additional inputs into strategic and business planning, marketing and communications, expanding industry engagement, commercialisation of IP and areas in which they have additional specific research expertise*	The CRC's relocation to the UON provides unique opportunities for CRC CARE, especially via collaboration with the NIER, which has in the past three years raised significant industry cash for research. To this end, the CRC's Managing Director has been actively collaborating with Dr Alan Broadfoot, Director of NIER, and leaders of other major research disciplines with the UON. Several new linkages have already been established. The CRC will develop a comprehensive program with UON to leverage their strengths in the areas identified by the panel.
4. *The CRC ensure that all outstanding matters with UniSA are resolved at the earliest opportunity and that staff and students impacted by the move to the University of Newcastle, are effectively supported. This is to include a formalised collaboration plan with UniSA, to ensure the continued involvement of high calibre researchers who were unable to make the move.*	The Chair and MD have made clear to UniSA and the SA Government our firm commitment to maintain an active and viable node of CRC CARE in Adelaide. This vision includes further development of initiatives with DoD, the SA Government and GM Holden, especially in relation to the assessment and remediation of contaminated sites. CRC CARE's Policy Program will remain with UniSA and researchers remaining with UniSA will continue to be engaged with the CRC through projects focusing on nanomaterials and TPH, as well as supervision of several CRC-supported PhD students. The ongoing activities of the CRC in SA are further supported by the strong relationship between CRC CARE and EPA SA. The MD has made extra effort to ensure continued collaboration with UniSA and to this end has had discussions on potential collaboration with the Interim Director of the university's newly established institute.
5. *Staff and students impacted by the move to the University of Newcastle, are effectively supported in their new location through the university's student welfare system.*	All the students and staff who relocated to UON completed the University's induction program. During orientation, UON offers a wide range of information sessions, tours, academic workshops and social activities to help students and staff integrate into their new community. UON Health and Welfare Advisers are assisting the new staff and students to connect with the right people for a range of issues, including disability support and online counselling.

Recommendation	Strategies to implement
6. *The CRC explores opportunities to play a more effective role in advising and supporting government and its agencies in areas of policy and practice where it has relevant expertise, e.g. in accelerating and improving the NEPM process. The CRC draws on its European and USA links for complementary inputs and assistance for its current and future research work in emerging contaminants. The CRC looks at avenues to showcase its know-how and achievements in the policy area in the USA, Asian and European forums, with a view to generating potential consultancies.*	The CRC has already played and will continue to play a significant role in influencing national and state site contamination policy and practice through acceptance of its science-based assessment guidance material through the NEPM processes. It will continue to pursue this core activity as it is the major reason for most end-user involvement in the CRC. Similarly, the CRC will maintain and develop its links into international forums where it can derive benefit in terms of access to complementary research and commercial opportunity. Specific examples of where the CRC has already been addressing this recommendation include the following: • CRC CARE is developing further guidance material that may readily be incorporated into the NEPM following its next review. • The development of the National Remediation Framework, through CRC CARE, with the involvement of all state environmental regulators, is a key initiative strongly supported by industry. When adopted by jurisdictions, it will harmonise remediation of contaminated sites across Australia, obviating the need for developing a NEPM-like instrument for remediation and thus enhancing the national guidance development process of which NEPMs are a part. • The effectiveness of NEPM implementation can arguably be enhanced by the SCP Australia scheme recently established by CRC CARE. • CRC CARE has and is further developing collaborations and links in these emerging potential markets throughout Asia (particularly China), which are likely to undergo significant contaminated sites policy development in coming years.
7. *The CRC develop a strategy to explore opportunities for further international student engagement in its research and education programs, with a focus on identifying, recruiting and retaining high quality students into the CRC. The strategy should explore the opportunity to develop the Masters program in collaboration with international institutes already providing such programs. The master's program should take advantage of innovations in delivery with a focus on industry input and industry endorsement of its content.*	The CRC already has an enviable record in attracting high quality students as well as collaborating with student projects in offshore universities, notably in China. We will continue to pursue this focus despite having already met the target PhD student numbers in the Commonwealth Agreement. We are conscious of the challenges in delivering master's programs and will continue to address such programs as recommended. An online master's degree will attract high-calibre international students.
8. *The CRC continues to develop the SCP Australia accreditation scheme for contamination consultants that includes a strategy to ensure regulator buy in, collaboration with other accreditation organisations (such as Soil Science Australia and Environmental Institute of Australia and New Zealand) and opportunities for expansion to Southeast Asia and elsewhere internationally.*	The implementation of the SCP Australia certification scheme continues to gain traction across all stakeholder groups, including regulators, consultants, industry and other end users such as local governments. CRC CARE initiated engagement with the Environment Institute of Australia and New Zealand (EIANZ) and Soil Science Australia during the development of the SCP Australia scheme. The Soils Science Australia scheme is not as comprehensive as SCP Australia. ACTRA was also consulted in the development of SCP Australia. The scheme's Executive Officer has conducted presentations to consultant networks (particularly ACLCA and ALGA) nationally.
9. *The CRC develop an international engagement strategy to explore international policy harmonisation program opportunities, potential international partners, and leverage research and policy development already achieved to expand knowledge transfer and ensure that returns to the CRC are maximised.*	While the primary focus of the CRC is national policy harmonisation, we have already established a number of international partnerships. We will review progress made thus far in international engagement and develop a strategic plan to guide further expansion of this activity. CRC CARE has initiated an international alliance, branded globalCARE™, or the Global Contamination and Remediation Enterprise. This is intended to be a global scientific initiative to define, quantify, set limits to, help clean up and devise new ways to curb the growing impact of chemical contamination on human health and the biosphere. We envisage this as an international alliance of leading scientific, government, industry and community organisations and individuals dedicated to making a cleaner, healthier and safer world. Still in the early stages of its formation, this new network represents an extraordinary opportunity for CRC CARE to be at the forefront of international development opportunities, including in relation to policy harmonisation. CRC CARE will develop an international engagement strategy for policy harmonisation by June 2016.
10. *The CRC formalise a plan for further engagement with SMEs and industry participants, which should include a services catalogue to market and appropriately explain its products.*	The CRC has productive relationships with end users, including SMEs, but we are very conscious of the constrained financial and delivery environment in which SMEs operate. We will seek to build on what has been achieved thus far in promoting and explaining what we offer, both with individual SMEs and strategically through their trade associations, most notably ALGA. To this end, CRC CARE and the ALGA Board have met once, and will meet again to develop strategies for collaboration.
11. *The CRC develop a plan to identify, protect and pursue the full potential of its IP. The plan should include a strategy for identifying IP at the early stages of research projects to develop and protect IP from research through to commercialisation.*	The CRC already has in place such a plan but we do not underestimate the challenges posed in implementing it. A pervasive issue for all CRCs is to balance the interests of researchers, for whom open publication of results is career-enhancing, against the drive for achieving commercial outcomes. We will continue to refine our IP identification, protection and exploitation plan and apply it as recommended.

Recommendation	Strategies to implement
12. *The CRC develop a strategic commercialisation strategy, consistent with the IP strategy, which focuses on the commercialisation potential of each key technology and/or combined service offering. The strategy should include an assessment of the national and global market opportunities, opportunities for forming partnerships and the path to market for each technology including rating IP on risk/return/effort metric so that the most lucrative opportunities are prioritised.*	We have been scoping the basis of a strategic commercialisation strategy in the context of operations beyond the term of Commonwealth funding. We accept that what has been achieved thus far is not yet in the form of a strategic business plan (as called for by Recommendation 14) and we will use what has been achieved thus far to articulate a strategy in accordance with the directions recommended. As a specific action, we intend to create a commercialisation committee of the Board with several external experts among its members.
13. *The CRC develop a marketing and communication strategy that exploits the full range of media available to enhance the marketing of research achievements to improve commercialisation opportunities and highlight the work and expertise of the CRC. The strategy should include an engagement and marketing strategy for each business offering and market opportunity that is suitably segmented and targeted. In addition, the CRC should develop the capacity of staff and students so that the achievements of the CRC can be effectively disseminated.*	The CRC has in place marketing and communications initiatives, including through our major CleanUp Conference and various media, including social media. We accept that these initiatives need to be embedded in a broad strategic framework and will work to build such a framework as recommended. CRC CARE has been working on a new marketing and communication strategy drawing on the relevant resources of UON. With a view to this, the CRC's Communication Manager met in April 2015 with several UON communication staff for preliminary discussions on how CRC CARE and the university (including NIER) might pool their resources and make use of each organisation's existing strengths. Once the transition to Newcastle is complete (by end 2015), the CRC CARE communication team will work with senior staff to redevelop the CRC's communication strategy. The new strategy will place a greater emphasis on marketing in light of the CRC's planned increase in commercial activities as it moves towards 2020 and the cessation of Commonwealth funding. It will also seek to increase the use of social/new media in engaging with all target audiences.
14. *The CRC creates a plan for the ongoing development of the CRC. This includes building the current transition plan into a robust strategic business plan which will guide the CRC as it endeavours to continue operating after the funding term. The plan should also include strategies for each research program to maximise opportunities, manage performance, meet milestones, and manage risks (both specific to the project, program and the organisation).*	The CRC accepts that the current transition plan needs to be focused into a business plan to guide activity beyond the funding term and the Board has already discussed its framing. The move to UON is a key component of our future business plan, as it will ensure we can establish an enduring centre of excellence in contamination assessment and remediation to link with components of ongoing commercial activity. We will develop from our transition plan the detail of our business plan over the next year, as recommended. Success in this endeavour will require assistance by UON, especially NIER.
15. *Financial matters* a. *The CRC review its financial position, including income and accrued expenses, and provide the department with an accurate figure of its current cash balance and projected position over the next 12 months* b. *The CRC undertake a review of all current and proposed activities to ensure that it can deliver activities under the current contracted resources from participants and the Commonwealth without the need to raise additional funds. Where all activities cannot be supported, the Board should terminate projects of least value to ensure the CRC can operate effectively and operate within its means for the remainder of the funding term. The Commonwealth will consider a request to vary the Commonwealth Agreement sympathetically.* c. *The CRC identify all projects where participant contributions have not been forthcoming, terminate these projects as appropriate and invoice participants with shortfalls for outstanding contributions.* d. *The CRC focus effort and expenditure on its obligations under the Commonwealth Agreement. Expenditure committed for activities under the Commonwealth Agreement must not be used for activities that fall outside the Agreement.*	a. A comprehensive budget and cash flow has been prepared for the 2015/16 financial year. The cash flow analysis demonstrates that CRC CARE has the ability to finance all activities for the ensuing year from current resources. b. At the request of CRC CARE's Audit and Risk Management Committee, external auditors (PricewaterhouseCoopers) have been retained to provide a report on the procedures in relation to project expenditure and the project management system. This review was conducted in July 2015. c. There are no projects currently active where participant contributions have not been forthcoming. All participants are invoiced quarterly in advance with the associated payments being carefully monitored. The participant contributions schedule is prepared on a quarterly basis and tracks each participant's payments against the requirement in the Commonwealth Agreement. d. CRC CARE has always focused effort to meet its obligations under the Commonwealth Agreement. All expenditure committed is and has been for activities that fall under the Commonwealth Agreement. All annual accounts produced for CRC CARE contain signed statements from the Managing Director and Finance Manager to this effect.

REQUIREMENTS FOR EXITING CRCS – FINAL ANNUAL REPORT

Not applicable.

REQUIREMENTS FOR EXTENSION CRCS – FINAL ANNUAL REPORT

Not applicable.

07 GLOSSARY OF TERMS

ACLCA
Australian Contaminated Land Consultants Association

ACTRA
Australasian College of Toxicology and Risk Assessment

AFFF
Aqueous film-forming foam

AIP
Australian Institute of Petroleum

AGM
Annual general meeting

ALGA
Australasian Land & Groundwater Association

BaP
Benzo[a]pyrene

BHPBIO
BHP Billiton Iron Ore Pty Ltd

CERAR
Centre for Environmental Risk Assessment and Remediation

CEO
Chief Executive Officer

CleanUp Conference
International Contaminated Site Remediation Conference

CRC
Cooperative Research Centre

CRC CARE
Cooperative Research Centre for Contamination Assessment and Remediation of the Environment

CSIRO
Commonwealth Scientific and Industrial Research Organisation

DNAPL
Dense non-aqueous phase liquid

DoD
Department of Defence

DSTO
Defence Science and Technology Organisation

EPA
Environment Protection Authority

GAC
granular activated carbon

HSLs
Health screening levels

HUNIC
Hub University of Industrial Collaboration

HUST
Huazhong University of Science and Technology

IITK
Indian Institute of Technology, Kanpur

IP
Intellectual property

ITRC
Interstate Technology & Regulatory Council

LIDAR
Laser radar

LATE
Lime-Assisted Tidal Exchange

LNAPL
Light non-aqueous phase liquid

NCSDP
National Contaminated Sites Demonstration Program

NEPM
National Environment Protection (Assessment of Site Contamination) Measure

NIER
Newcastle Institute for Energy and Resources

NMI
National Measurement Institute

NSW
New South Wales

PAH
Polycyclic aromatic hydrocarbon

PCT
Patent Cooperation Treaty

PFCs
Perfluorochemicals

PFOA
Perfluorooctanoic acid

PFOS
Perfluorooctanesulfonic acid

PM10
Particulate matter 10 micrometers or less in diameter

SA
South Australia

SCP Australia
Site Contamination Practitioners Australia

SCU
Southern Cross University

SME
Small-to-medium enterprise

TCE
Trichloroethylene

TPH
Total petroleum hydrocarbon

UniSA
University of South Australia

UK
United Kingdom

USA
United States of America

UON
University of Newcastle

UQ
University of Queensland

UTS
University of Technology, Sydney

UWS
University of Western Sydney

VOCs
Volatile organic compounds

WA
Western Australia

08 PUBLICATIONS

JOURNAL PAPERS

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09 FINANCIAL REPORT

CRC CARE PTY LTD ACN 113 908 044

COOPERATIVE RESEARCH CENTRE FOR CONTAMINATION ASSESSMENT AND REMEDIATION OF THE ENVIRONMENT

FINANCIAL REPORT FOR THE YEAR ENDED 30 JUNE 2015

Contents

These financial statements are the financial statements of CRC CARE Pty Ltd as an individual entity. The financial statements are presented in the Australian currency.

CRC CARE Pty Ltd is a company limited by shares, incorporated and domiciled in Australia. Its registered office and principal place of business is:

CRC CARE Pty Ltd
Building X
University of South Australia
Mawson Lakes SA 5095

The financial statements were authorised for issue by the Directors on 30 October 2015. The Directors have the power to amend and reissue the financial statements.

Directors' report

In respect of the financial year ended 30 June 2015, the Directors of CRC CARE Pty Ltd (the "Company" or "CRC CARE") submit the following report made out in accordance with a resolution of the Board of Directors.

Board of Directors

The following persons held office as Directors of CRC CARE Pty Ltd during the financial year:

Dr Peter Jonson, Chairman
Prof Ravi Naidu, CEO & Managing Director
Ms Bronwyn Constance (appointed 2 December 2014)
Ms Beth Laughton (resigned 2 December 2014)
Dr Rod Lukatelich
Dr Stephen Rodda
Adj Prof Donald Sinnott
Ms Anthea Tinney
Dr Paul Vogel
Mr Charles Wong

Principal activities of the Company

The Company was incorporated to manage and govern the Cooperative Research Centre for Contamination Assessment and Remediation of the Environment ("the Centre").

The objective of the Centre is to promote research and capacity building for the development and extension of advanced technologies and methods for:

(a) assessing contamination risks to land, groundwater and air;
(b) preventing, managing and/or remediating contamination;
(c) developing safe options for land use and the reuse of wastes on land;
(d) developing solutions that are acceptable to regulatory agencies and the public; and
(e) capacity building.

Dividends

There were no dividends declared or paid to shareholders during the year ended 30 June 2015 (2014: $nil).

Review of operations

The Company specialises in research and development of technologies to overcome and prevent contamination of soil, water and air. During the period, the Company received cash contributions of $6,968,203 (2014: $13,455,750) and in-kind contributions of $11,363,593 (2014: $13,085,108).

Costs directly attributable to Research expenditure totalled $20,471,550 (2014: $23,993,935) which was reflective of the status and number of projects undertaken during the period.

During the year ended 30 June 2015, the Company experienced a loss of $559,809 (2014: $nil) due to expenditure on projects that have been brought forward. Any future contributions for these projects have not met the accounting definition for revenue recognition.

Significant changes in the state of affairs

During the latter part of 2014, CRC CARE was advised that the University of South Australia (Mawson Lakes Campus) were instituting a new model styled the Future Industries Institute. This model would absorb a number of current Institutes/Schools with the Centre for Environmental Risk Assessment and Remediation ("CERAR") being among these. Given the close working relationship between CERAR and CRC CARE, the decision taken by UniSA became the subject of intense and prolonged negotiations.

A decision was taken by the Board of CRC CARE to relocate the operations of CRC CARE to the University of Newcastle in view of the opportunities and synergies presented for both CERAR and CRC CARE.

Significant changes in the state of affairs (continued)

There have been no other significant changes in the state of affairs of the Company during the year.

Matters subsequent to the end of the financial year

No matter or circumstance has arisen since 30 June 2015 that has significantly affected, or may significantly affect:

(a) the Company's operations in future financial years, or
(b) the results of those operations in future financial years, or
(c) the Company's state of affairs in future financial years.

Likely developments and expected results of operations

Information on likely developments in the operations of the Company and the expected results of operations have not been included in this financial report because the Directors believe it would be likely to result in unreasonable prejudice to the Company.

Environmental regulation

The entity is subject to significant environmental regulation relating to the testing of contaminated sites and the formulation of proposals for the remediation of contamination in the environment.

Personnel of the entity and entities providing research services to the Company are required to conform to the site specific Environmental Health and Safety plans when entering and working on contaminated sites.

There have been no breaches of such environmental regulations or plans that have a material effect on the financial statements.

Insurance of directors and officers

During the financial year, the Company paid a premium of $7,143 (2014: $7,143) to insure Directors and Officers of the Company.

The liabilities insured are legal costs that may be incurred in defending civil or criminal proceedings that may be brought against Directors and Officers in their capacity as officers of the Company, and any other payments arising from liabilities incurred by the officers in connection with such proceedings. This does not include such liabilities that arise from conduct involving wilful breach of duty by the officers or the improper use by the officers of their position or of information to gain advantage for them or someone else or to cause detriment to the Company.

Auditor's independence declaration

A copy of the auditor's independence declaration as required under section 307C of the *Corporations Act 2001* is set out on page 3.

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

For and on behalf of the Directors

Dr Peter Jonson
Chairman

Prof Ravi Naidu
CEO & Managing Director

30-10- 2015

These financial statements are the financial statements of CRC CARE Pty Ltd as an individual entity. The financial statements are presented in the Australian currency.

CRC CARE Pty Ltd is a company limited by shares, incorporated and domiciled in Australia. Its registered office and principal place of business is:

CRC CARE Pty Ltd
Building X
University of South Australia
Mawson Lakes SA 5095

The financial statements were authorised for issue by the Directors on 30 October 2015. The Directors have the power to amend and reissue the financial statements.

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Auditor's Independence Declaration

As lead auditor for the audit of CRC CARE Pty Ltd for the year ended 30 June 2015, I declare that to the best of my knowledge and belief, there have been:

a) no contraventions of the auditor independence requirements of the *Corporations Act 2001* in relation to the audit; and

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

MT Lojszczyk
Partner
PricewaterhouseCoopers

Adelaide
30 October 2015

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STATEMENT OF COMPREHENSIVE INCOME
FOR THE YEAR ENDED 30 JUNE 2015

	NOTES	2015 $	2014 $
REVENUE			
Revenue from continuing operations	**3**	**22,819,053**	**26,757,554**
EXPENSES			
Consultants fees		(238,036)	(143,031)
Employee benefits expense		(1,509,687)	(1,428,555)
IT expenses		(168,393)	(186,763)
Legal expenses		(96,136)	(122,179)
Research expenditure – cash		(9,107,957)	(10,908,827)
Research expenditure – in-kind		(11,363,593)	(13,085,108)
Travel		(150,922)	(155,883)
Other expenses	4	(692,574)	(718,655)
Finance costs		(5,135)	(4,411)
Total expenses		**(23,332,433)**	**(26,753,412)**
NET PROFIT/(LOSS) ATTRIBUTABLE TO MEMBERS OF CRC CARE BEFORE INCOME TAX		**(513,380)**	**4,142**
Income tax expense	5	(46,429)	(4,142)
NET PROFIT/(LOSS) ATTRIBUTABLE TO MEMBERS OF CRC CARE		(559,809)	-
Other comprehensive income for the year, net of tax		-	-
TOTAL COMPREHENSIVE INCOME		**(559,809)**	-

The above statement of comprehensive income should be read in conjunction with the accompanying notes.

STATEMENT OF FINANCIAL POSITION
AS AT 30 JUNE 2015

	NOTES	2015 $	2014 $
ASSETS			
CURRENT ASSETS			
Cash and cash equivalents	6	810,726	4,686,601
Financial assets	7	2,000,000	3,000,000
Trade and other receivables	8	485,510	580,625
Prepayments		161,505	141,211
Total current assets		**3,457,741**	**8,408,437**
NON-CURRENT ASSETS			
Property, plant and equipment	9	132,952	-
Deferred tax assets		-	39,750
Total non-current assets		132,952	39,750
TOTAL ASSETS		**3,590,693**	**8,448,187**
LIABILITIES			
CURRENT LIABILITIES			
Payables	10	3,229,144	2,645,551
Provision for employee entitlements	11	124,805	201,714
Accrued expenses		491,374	1,331,304
Deferred revenue	12	254,545	4,232,576
Total current liabilities		**4,099,868**	**8,411,145**
NON CURRENT LIABILITIES			
Provisions for employee entitlements		50,621	37,029
Total non-current liabilities		**50,621**	**37,029**
TOTAL LIABILITIES		**4,150,489**	**8,448,174**
NET ASSETS		**(559,796)**	**13**
EQUITY			
Contributed equity	13	13	13
Accumulated losses		(559,809)	-
TOTAL EQUITY		**(559,796)**	**13**

The above statement of financial position should be read in conjunction with the accompanying notes.

STATEMENT OF CHANGES IN EQUITY
FOR THE YEAR ENDED 30 JUNE 2015

	CONTRIBUTED EQUITY $	ACCUMULATED PROFIT $	TOTAL $
BALANCE AT 1 JULY 2013	12	-	12
Total comprehensive income for the year	-	-	-
TRANSACTIONS WITH OWNERS IN THEIR CAPACITY AS OWNERS:			
Total shareholder changes for the year	1	-	1
BALANCE AT 30 JUNE 2014	**13**	**-**	**13**
BALANCE AT 1 JULY 2014	**13**	**-**	**13**
Loss for the year	-	(559,809)	(559,809)
Total comprehensive loss for the year	-	(559,809)	(559,809)
BALANCE AT 30 JUNE 2015	**13**	**(559,809)**	**(559,796)**

The above statement of changes in equity should be read in conjunction with the accompanying notes.

STATEMENT OF CASH FLOWS
FOR THE YEAR ENDED 30 JUNE 2015

	NOTES	2015 $	2014 $
CASH FLOWS FROM OPERATING ACTIVITIES			
Cash contributions received from Commonwealth (inclusive of GST)		3,437,200	9,383,000
Cash contributions received from all Participants (inclusive of GST)		4,505,957	4,500,573
Payments to suppliers and employees		(13,442,365)	(12,892,314)
Income tax paid		(6,679)	(4,142)
Training fees		71,337	248,043
Other income		464,891	79,472
Grant income		107,04	-
NET CASH (OUTFLOW) INFLOW FROM OPERATING ACTIVITIES	21	**(4,862,616)**	**1,314,632**
CASH FLOWS FROM INVESTING ACTIVITIES			
Payments for property, plant and equipment	9	(132,952)	-
Receipt of term deposits		3,000,000	3,000,000
Investment in term deposits		(2,000,000)	(3,000,000)
Interest received		119,693	182,068
NET CASH INFLOW FROM INVESTING ACTIVITIES		**986,741**	**182,068**
CASH FLOWS FROM FINANCING ACTIVITIES			
Proceeds from issues of share		-	1
NET CASH INFLOW FROM FINANCING ACTIVITIES		**-**	1
NET (DECREASE) INCREASE IN CASH AND CASH EQUIVALENTS		**(3,875,875)**	**1,496,701**
Cash and cash equivalents at the beginning of the financial year		4,686,601	3,189,900
CASH AND CASH EQUIVALENTS AT THE END OF THE FINANCIAL YEAR		**810,726**	**4,686,601**

The above statement of cash flows should be read in conjunction with the accompanying notes.

NOTES TO THE FINANCIAL STATEMENTS 30 JUNE 2015

1 Summary of significant accounting policies

The principal accounting policies adopted in the preparation of the Company's financial statements are set out below. These policies have been consistently applied to all the years presented, unless otherwise stated.

(A) BASIS OF PREPARATION

(i) Special purpose financial report

In the Directors' opinion, CRC CARE Pty Ltd (the "Company") is not a reporting entity because there are no users dependent on general purpose financial reports.

This is a special purpose financial report that has been prepared for the sole purpose of complying with the *Corporations Act 2001* requirements to prepare and distribute a financial report to the members and must not be used for any other purpose.

The financial report has 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*. It contains only those disclosures considered necessary by the Directors to meet the needs of the members. CRC CARE Pty Ltd is a for-profit entity for the purpose of preparing the financial statements.

(ii) New and amended standards adopted by the Company

None of the new standards and amendments to standards that are mandatory for the first time for the financial year beginning 1 July 2013 affected any of the amounts recognised in the current period or any prior period and are not likely to affect future periods.

(iii) Early adoption of standards

The Company has not elected to apply any pronouncements before their operative date in the annual reporting period beginning 1 July 2014.

(iv) Historical cost convention

These financial statements have been prepared under the historical cost convention.

(v) Critical accounting estimates

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. The areas involving a higher degree of judgement or complexity, or areas where assumptions and estimates are significant to the financial statements, are disclosed in note 2.

(vi) Going concern

As at 30 June 2015, the Company has a deficiency of capital and reserves of $559,796 and a working capital deficiency of $642,127. The Company has also experienced substantial operating losses and negative cash flows during the financial year ending on that date. The continuing viability of the Company and its ability to continue as a going concern and meet its debts and commitments as they fall due are dependent upon the Company being successful in:

i. receiving the continuing support of the Participants and the Commonwealth of Australia;

ii. negotiating additional funding; and

iii. achieving sufficient future cash flows to enable its obligations to be met.

As a result of these matters, there is a material uncertainty that may cast significant doubt on the Company's ability to continue as a going concern and, therefore, that it may be unable to realise its assets and discharge its liabilities in the normal course of business.

However, the Directors believe that the Company will be successful in the above matters and, accordingly, have prepared the financial report on a going concern basis.

(B) REVENUE RECOGNITION

(i) Government grants

Grants from the government are recognised at their fair value where there is a reasonable assurance that the grant will be received and the Company will comply with all attached conditions.

Government grants relating to costs which have not yet been incurred are included in deferred income 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.

Government grants relating to the purchase of property, plant and equipment are included in non-current liabilities as deferred income and are credited to the statement of comprehensive income over the expected lives of the related assets.

(ii) Participants' contributions

Contributions received in cash (recorded as deferred income on receipt – for further information refer note 12) 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 received in-kind are recognised as detailed in note 1(c) and comprise material, labour and other costs, when sufficient documentation and information has been received to quantify the cost with reasonable certainty.

Contributions as detailed in note 14 are calculated on a cash basis for reporting purpose to Commonwealth of Australia.

(C) IN-KIND CONTRIBUTIONS

In-kind contributions of staff by research providers are valued in accordance with the Commonwealth Agreement, as per Table 1 of 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 equivalent service from a commercial operator.

Office and laboratory accommodation is provided by the University of South Australia as part of the participant's agreement and are treated as in-kind contributions. Laboratory accommodation is provided by other Participants as part of the Participant's agreement and is 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.

(D) CASH AND CASH EQUIVALENTS

Cash and cash equivalents includes 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.

(E) FINANCIAL ASSETS

Financial assets relate to term deposits held to maturity with an original maturity of more than three months at the inception of the instrument.

(F) TRADE AND OTHER RECEIVABLES

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

Collectability of trade receivables is reviewed on an ongoing basis. Debts which are known to be uncollectible are written off. A provision for doubtful debts is used when there is objective evidence that the Company will not be able to collect all amounts due according to the original terms of the receivables. The amount of the provision is the difference between the asset's carrying amount and the present value of estimated future cash flows, discounted at the original effective interest rate. The amount of the provision is recognised in the statement of comprehensive income.

(G) IMPAIRMENT OF ASSETS

Assets that have an indefinite useful life are not subject to amortisation and are tested annually for impairment. 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).

(H) PLANT AND EQUIPMENT

Plant and equipment is stated at historical cost less depreciation. Historical cost includes expenditure that is directly attributable to the acquisition of the items.

Subsequent costs are included in the asset's carrying amount or recognised as a separate asset, as appropriate, only when it is probable that future economic benefits associated with the item will flow to the Company and the cost of the item can be measured reliably. The carrying amount of any component accounted for as a separate asset is derecognised when replaced.

Depreciation is calculated using the straight-line method to allocate their cost or revalued amounts, net of their residual values, over their estimated useful lives.

Plant and equipment is depreciated over the useful life of 10 years.

The assets' residual values and useful lives are reviewed, and adjusted if appropriate, at the end of each reporting period.

An asset's carrying amount is written down immediately to its recoverable amount if the asset's carrying amount is greater than its estimated recoverable amount (note 1(g)).

Gains and losses on disposals are determined by comparing proceeds with carrying amount. These are included in profit or loss.

(I) 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.

(J) 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 liability for long service leave is recognised in the provision for employee benefits and measured as the present value of expected future payments to be made in respect of services provided by employees up to the reporting date 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 reporting date on national government bonds with terms to maturity and currency that match, as closely as possible, the estimated future cash outflows.

(K) CONTRIBUTED EQUITY

Ordinary shares are classified as equity.

Incremental costs directly attributable to the issue of new shares or options are shown in equity as a deduction, net of tax, from the proceeds.

(J) RESEARCH EXPENDITURE

Research expenses 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.

Equipment costs relate to expenses incurred in the procurement of equipment to assist directly with the research programs undertaken. Consumable and travel costs are incurred on an ongoing basis and relate to day to day expenses incurred as part of the research activities. Research expenditure is accounted for on an accrual basis.

(M) INCOME TAX

The income tax expense or revenue for the period is the tax payable/(receivable) on the current period's taxable income based on the notional income tax rate adjusted by changes in deferred tax assets and liabilities attributable to temporary differences between the tax bases of assets and liabilities and their carrying amounts in the financial statements, and to unused tax losses.

Deferred tax assets and liabilities are recognised for temporary differences at the tax rates expected to apply when the assets are recovered or liabilities are settled, based on those tax rates which are enacted or substantively enacted for each jurisdiction.

The relevant tax rates are applied to the cumulative amounts of deductible and taxable temporary differences to measure the deferred tax asset or liability. An exception is made for certain temporary differences arising from the initial recognition of an asset or a liability. No deferred tax asset or liability is recognised in relation to these temporary differences if they arose in a transaction, other than a business combination, that at the time of the transaction did not affect either accounting profit or taxable profit or loss. Deferred tax assets are recognised for deductible temporary differences and unused tax losses only if it is probable that future taxable amounts will be available to utilise those temporary differences and losses.

Current and deferred tax balances attributable to amounts recognised directly in equity are also recognised directly in equity.

(N) COMPARATIVE FIGURES

When required by Accounting Standards, comparative figures have been adjusted to conform to changes in presentation for the current financial year. In particular, employee benefits expense, research expenditure – cash, other expenses, income tax expense, trade and other receivables, prepayments and payables have been reclassified to enhance relevance and comparability. As a result, payments to suppliers and employees, income tax paid, training fees and other income were reclassified in the cash flows from operating activities. These changes had no impact on net profit, net assets or net operating cash flows.

2 Critical accounting estimates and judgements

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.

In-kind contributions

There is an element of estimation and judgement to the value of 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 1(c). The actual time (which affects total value) 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.

Recoverability of deferred tax assets

The Company holds deferred tax assets relating to carried forward tax losses and other timing differences to the extent that there are forecast taxable temporary differences against which they can be used. Due to uncertainty as to the forecast taxable income, deferred tax assets have been derecognised in the current period.

3 Revenue from continuing operations

	2015 $	2014 $
Allocated contributions from Participants – cash	10,751,575	13,192,636
Allocated contributions from Participants – in-kind	11,363,593	13,085,108
Interest received or due and receivable	119,693	182,068
Training fees	64,852	225,494
Other income	422,028	72,248
Grant income	97,312	-
TOTAL REVENUE	**22,819,053**	**26,757,554**

4 Other expenses

	2015 $	2014 $
Education and training expenses *	75,052	183,338
Board expenses	9,853	7,340
Insurance premium	138,827	136,678
Compliance costs	101,830	159,074
Communications	149,905	108,457
Relocation costs	103,776	-
Other	113,332	123,768
TOTAL OTHER EXPENSES	**692,575**	**718,655**

* The majority of the education and training expenses relate to the cost of generating training fees of $64,852 (2014: $225,494)

5 Income tax expense

	2015 $	2014 $
Current tax expense (benefit)	6,679	(5,796)
Deferred tax expense	39,750	9,938
INCOME TAX EXPENSE	**46,429**	**4,142**

Due to uncertainty regarding the forecasted taxable income, no deferred tax asset was recorded related to the loss for the year ended 30 June 2015.

6 Current assets – Cash and cash equivalents

	2015 $	2014 $
Cash on hand	500	500
Cash at bank	245,769	96,452
Cash management account	564,457	4,589,649
TOTAL CASH AND CASH EQUIVALENTS	**810,726**	**4,686,601**

For the purposes of the statement of cash flows, cash includes the above balances.

7 Current assets – Financial assets

	2015 $	2014 $
Term deposits	2,000,000	3,000,000
	2,000,000	**3,000,000**

Term deposits classified as financial assets have an original maturity of more than three months at inception of the instrument.

8 Current assets – Trade and other receivables

	2015 $	2014 $
Trade receivables	118,210	536,455
Other receivables	367,300	44,170
	485,510	**580,625**

9 Non-current assets – Plant and equipment

	PLANT AND EQUIPMENT $	TOTAL $
YEAR ENDED 30 JUNE 2015		
Opening net book amount	-	-
Additions	139,189	139,189
Depreciation charge	(6,237)	(6,237)
Closing net book amount	**132,952**	**132,952**
AT 30 JUNE 2015		
Cost	139,189	139,189
Accumulated depreciation	(6,237)	(6,237)
Net book amount	**132,952**	**132,952**

10 Current liabilities – Payables

	2015 $	2014 $
Accounts payable	3,145,301	2,509,250
Other payables	83,843	136,301
TOTAL PAYABLES	**3,229,144**	**2,645,551**

11 Current liabilities – Provision for employee entitlements

	2015 $	2014 $
Provision for employee entitlements (a)	124,805	201,714
	124,805	**201,714**

(a) Amounts not expected to be settled within 12 months

The current provision for employee benefits includes accrued annual leave and long service leave. Long service leave covers all unconditional entitlements where employees have completed the required period of service and also those where employees are entitled to pro-rata payments in certain circumstances. The entire amount of the provision of $124,805 (2014: $201,714) is presented as current, since the Company does not have an unconditional right to defer settlement for any of these obligations. However, based on past experience, the Company does not expect all employees to take the full amount of accrued leave or require payment within the next 12 months. The following amounts reflect leave that is not to be expected to be taken or paid within the next 12 months.

	2015 $	2014 $
Current leave obligations expected to be settled after 12 months	33,799	105,598

12 Current liabilities – Deferred revenue

	2015 $	2014 $
Contributions from Commonwealth and Participants	254,545	4,232,576
	254,545	**4,232,576**

As per the accounting policy in note 1, 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.

13 Contributed equity

(A) SHARE CAPITAL

	2015 SHARES	2014 SHARES	2015 $	2014 $
Ordinary shares				
Issued share capital	**13**	13	**13**	13

(B) ORDINARY SHARES

Ordinary shares entitle the holder to the right to receive notice of and to attend and vote at all general meetings of the Company. On a show of hands, a member is entitled to one vote. On a poll, the number of votes is in proportion to the total level of contribution to CRC CARE Pty Ltd, made up to the financial year prior to which the vote is taken.

If the Company is wound up, any assets remaining after payment of the debts and liabilities of the Company, inclusive of intellectual property, will be divided amongst Participants proportionate to their contributed percentage as at the date of the division of assets.

14 Participants' contributions (cash basis ex GST as per note1(b)(ii))

	2015 $	2014 $	CUMULATIVE 2005 TO 2013 $	TOTAL $
AGILENT TECHNOLOGIES AUSTRALIA PTY LTD				
Cash contributions	-	-	25,000	25,000
In-kind contributions				
- Salaries	-	-	-	-
- Other	-	202,000	287,870	489,870
TOTAL	-	**202,000**	**312,870**	**514,870**
ALCOA WORLD ALUMINA AUSTRALIA				
Cash contributions	-	-	150,000	150,000
In-kind contributions				
- Salaries	-	-	94,750	94,750
- Other	-	-	-	-
TOTAL	-	-	**244,750**	**244,750**
AUSTRALIAN INSTITUTE OF PETROLEUM LTD				
Cash contributions	**250,000**	250,000	1,700,000	2,200,000
In-kind contributions				
- Salaries	**105,229**	131,639	390,869	627,737
- Other	-	-	55,385	55,385
TOTAL	**355,229**	**381,639**	**2,146,254**	**2,883,122**
BHP BILLITON IRON ORE				
Cash contributions	**745,455**	1,569,062	2,939,055	5,253,572
In-kind contributions				
- Salaries	**101,262**	483,569	763,509	1,348,340
- Other	**15,600**	270,000	81,000	366,600
TOTAL	**862,317**	**2,322,631**	**3,783,564**	**6,968,512**

14 Participants' contributions (cash basis ex GST as per note1(b)(ii))

	2015 $	2014 $	CUMULATIVE 2005 TO 2013 $	TOTAL $
CSIRO				
Cash contributions	-	-	-	-
In-kind contributions				
- Salaries	314,771	332,952	487,780	1,135,503
- Other	-	-	-	-
TOTAL	**314,771**	**332,952**	**487,780**	**1,135,503**
CHEMISTRY CENTRE, DEPARTMENT OF INDUSTRY AND RESOURCES (WESTERN AUSTRALIA)				
Cash contributions	125,000	125,000	1,000,000	1,250,000
In-kind contributions				
- Salaries	195,431	234,951	1,359,051	1,789,433
- Other	14,307	342,943	641,600	998,850
TOTAL	**334,738**	**702,894**	**3,000,651**	**4,038,283**
CH2MHILL AUSTRALIA PTY LTD				
Cash contributions	15,000	15,000	90,000	120,000
In-kind contributions				
- Salaries	12,233	3,749	9,000	24,982
- Other	-	-	-	-
TOTAL	**27,233**	**18,749**	**99,000**	**144,982**
COFFEY ENVIRONMENTS LTD				
Cash contributions	-	-	90,000	90,000
In-kind contributions				
- Salaries	-	-	38,850	38,850
- Other	-	-	-	-
TOTAL	**-**	**-**	**128,850**	**128,850**
CURTIN UNIVERSITY				
Cash contributions	150,000	150,000	1,063,100	1,363,100
In-kind contributions				
- Salaries	796,066	671,253	1,689,916	3,157,235
- Other	11,875	58,127	141,249	211,251
TOTAL	**957,941**	**879,380**	**2,894,265**	**4,731,586**
DEPARTMENT OF DEFENCE				
Cash contributions	924,498	1,427,938	24,231,357	26,583,793
In-kind contributions				
- Salaries	-	106,515	370,167	476,682
- Other	-	-	-	-
TOTAL	**924,498**	**1,534,453**	**24,601,524**	**27,060,475**
DEPARTMENT OF ENVIRONMENT REGULATION (WESTERN AUSTRALIA)				
Cash contributions	-	-	2,068,444	2,068,444
In-kind contributions				
- Salaries	7,332	46,047	288,933	342,312
- Other	-	-	-	-
TOTAL	**7,332**	**46,047**	**2,357,377**	**2,410,756**
ENVIRONMENT PROTECTION AUTHORITY (SOUTH AUSTRALIA)				
Cash contributions	100,000	100,000	800,000	1,000,000
In-kind contributions				
- Salaries	16,506	-	148,900	165,406
- Other	-	-	-	-
TOTAL	**116,506**	**100,000**	**948,900**	**1,165,406**
ENVIRONMENT PROTECTION AUTHORITY (VICTORIA)				
Cash contributions	50,000	50,000	400,000	500,000
In-kind contributions				
- Salaries	98,309	112,649	258,500	469,458
- Other	-	4,000	-	4,000
TOTAL	**148,309**	**166,649**	**658,500**	**973,458**
FIBRECELL PTY LTD				
Cash contributions	-	-	-	-
In-kind contributions				
- Salaries	-	-	80,000	80,000
- Other	-	-	-	-
TOTAL	**-**	**-**	**80,000**	**80,000**
GHD PTY LTD				
Cash contributions	20,000	20,000	406,227	446,227
In-kind contributions				
- Salaries	67,840	36,310	258,440	362,590
- Other	-	-	1,606	1,606
TOTAL	**87,840**	**56,310**	**666,273**	**810,423**

	2015 $	2014 $	CUMULATIVE 2005 TO 2013 $	TOTAL $
HLM ASIA GROUP LIMITED				
Cash contributions	**625,000**	375,000	4,000,000	5,000,000
In-kind contributions				
- Salaries	**1,231,000**	1,231,000	12,021,967	14,483,967
- Other	**-**	-	-	-
TOTAL	**1,856,000**	**1,606,000**	**16,021,967**	**19,483,967**
JAMES COOK UNIVERSITY				
Cash contributions	**-**	-	300,000	300,000
In-kind contributions				
- Salaries	**49,513**	34,000	268,525	352,038
- Other	**-**	-	-	-
TOTAL	**49,513**	**34,000**	**568,525**	**652,038**
SOUTHERN CROSS UNIVERSITY				
Cash contributions	**100,000**	100,000	800,000	1,000,000
In-kind contributions				
- Salaries	**816,125**	1,064,342	1,981,775	3,862,242
- Other	**725,191**	883,959	1,874,892	3,484,042
TOTAL	**1,641,316**	**2,048,301**	**4,656,667**	**8,346,284**
RIO TINTO SERVICES				
Cash contributions	**50,000**	50,000	400,000	500,000
In-kind contributions				
- Salaries	**-**	64,738	334,430	399,168
- Other	**-**	-	44,629	44,629
TOTAL	**50,000**	**114,738**	**779,059**	**943,797**
THE UNIVERSITY OF QUEENSLAND				
Cash contributions	**150,000**	150,000	900,000	1,200,000
In-kind contributions				
- Salaries	**450,333**	450,334	2,815,332	3,715,999
- Other	**526,583**	395,883	3,322,607	4,245,073
TOTAL	**1,126,916**	**996,217**	**7,037,939**	**9,161,072**
UNIVERSITY OF SOUTH AUSTRALIA				
Cash contributions	**250,000**	250,000	2,000,000	2,500,000
In-kind contributions				
- Salaries	**1,868,450**	1,758,500	8,199,775	11,826,725
- Other	**1,576,446**	1,935,712	6,230,203	9,742,361
TOTAL	**3,694,896**	**3,944,212**	**16,429,978**	**24,069,086**
UNIVERSITY OF TECHNOLOGY, SYDNEY				
Cash contributions	**150,000**	150,000	600,000	900,000
In-kind contributions				
- Salaries	**1,072,600**	702,169	2,314,088	4,088,857
- Other	**124,100**	171,715	635,418	931,233
TOTAL	**1,346,700**	**1,023,884**	**3,549,506**	**5,920,090**
VICTORIAN URBAN DEVELOPMENT AUTHORITY (VICURBAN)				
Cash contributions	**-**	-	120,000	120,000
In-kind contributions				
- Salaries	**-**	-	-	-
- Other	**-**	-	-	-
TOTAL	**-**	**-**	**120,000**	**120,000**
VERUTEK				
Cash contributions	**-**	-	37,312	37,312
In-kind contributions				
- Salaries	**-**	15,000	-	15,000
- Other	**-**	-	-	-
TOTAL	**-**	**15,000**	**37,312**	**52,312**
CHEVRON AUSTRALIA				
Cash contributions	**50,000**	50,000	180,000	280,000
In-kind contributions				
- Salaries	**-**	-	7,950	7,950
- Other	**-**	-	-	-
TOTAL	**50,000**	**50,000**	**187,950**	**287,950**

14 Participants' contributions (cash basis ex GST as per note1(b)(ii)) (continued)

	2015 $	2014 $	CUMULATIVE 2005 TO 2013 $	TOTAL $
MOBIL AUSTRALIA (THIRD PARTY)				
Cash contributions	-	-	1,617,103	1,617,103
In-kind contributions				
- Salaries	-	-	-	-
- Other	-	-	-	-
TOTAL	**-**	**-**	**1,617,103**	**1,617,103**
QUEENSLAND DEPARTMENT OF SCIENCE, INFORMATION TECHNOLOGY AND INNOVATION				
Cash contributions	-	-	1,493,088	1,493,088
In-kind contributions				
- Salaries	**338,000**	547,736	1,405,058	2,290,794
- Other	**61,744**	204,815	1,387,877	1,654,436
TOTAL	**399,744**	**752,551**	**4,286,023**	**5,438,318**
OTHER COMMONWEALTH (THIRD PARTY)				
Cash contributions	-	-	213,615	213,615
In-kind contributions				
- Salaries	-	-	-	-
- Other	-	-	-	-
TOTAL	**-**	**-**	**213,615**	**213,615**
SCHOLARSHIP SUPPORT (THIRD PARTY)				
Cash contributions	-	-	-	-
In-kind contributions				
- Salaries	-	-	233,750	233,750
- Other	-	-	-	-
TOTAL	**-**	**-**	**233,750**	**233,750**
NMI				
Cash contributions	-	-	-	-
In-kind contributions				
- Salaries	**397,315**	404,254	425,828	1,227,397
- Other	**144,674**	80,950	44,615	270,239
TOTAL	**541,989**	**485,204**	**470,443**	**1,497,636**
HORT RESOURCES (THIRD PARTY)				
Cash contributions	-	-	-	-
In-kind contributions				
- Salaries	-	-	6,400	6,400
- Other	-	-	25,000	25,000
TOTAL			**31,400**	**31,400**
LAASE & RUMBAUGH (THIRD PARTY)				
Cash contributions	-	-	-	-
In-kind contributions				
- Salaries	-	-	-	-
- Other	-	-	10,400	10,400
TOTAL	**-**	**-**	**10,400**	**10,400**
JBS&G (SOIL & GROUNDWATER)				
Cash contributions	**18,750**	43,750	25,000	87,500
In-kind contributions				
- Salaries	-	-	-	-
- Other	-	-	-	-
TOTAL	**18,750**	**43,750**	**25,000**	**87,500**
OTHER (THIRD PARTY)				
Cash contributions	-	-	34,780	34,780
In-kind contributions				
- Salaries	-	-	38,550	38,550
- Other	-	-	-	-
TOTAL	**-**	**-**	**73,330**	**73,330**
CAPITAL TECHNIC GROUP PTY LTD.				
Cash contributions	-	-	160,000	160,000
In-kind contributions				
- Salaries	-	-	-	-
- Other	-	-	8,000	8,000
TOTAL	**-**	**-**	**168,000**	**168,000**
WORSLEY ALUMINA PTY LTD				
Cash contributions	-	-	150,000	150,000
In-kind contributions				
- Salaries	-	-	13,500	13,500
- Other	-	-	-	-
TOTAL	**-**	**-**	**163,500**	**163,500**

	2015 $	2014 $	CUMULATIVE 2005 TO 2013 $	TOTAL $
UNIVERSITY OF WESTERN SYDNEY				
Cash contributions	**50,000**	50,000	-	100,000
In-kind contributions				
- Salaries	**66,683**	29,698	-	96,381
- Other	**140,075**	73,600	-	213,675
TOTAL	**256,758**	153,298	**-**	**410,056**
RMIT UNIVERSITY				
Cash contributions	**100,000**	-	-	100,000
In-kind contributions	**-**			
- Salaries		-	-	-
- Other	**-**	-	-	-
TOTAL	**100,000**	**-**	**-**	**100,000**
UNIVERSITY OF NEWCASTLE				
Cash contributions	**187,500**	-	-	187,500
In-kind contributions	**-**			
- Salaries		-	-	-
- Other	**-**	-	-	-
TOTAL	**187,500**	**-**	**-**	**187,500**
ACLCA				
Cash contributions	**5,000**	-	-	5,000
In-kind contributions	**-**			
- Salaries		-	-	-
- Other	**-**	-	-	-
TOTAL	**5,000**	**-**	**-**	**5,000**
PACIFIC ENVIRONMENT				
Cash contributions	**-**	-	-	-
In-kind contributions				
- Salaries	**18,000**	-	-	18,000
- Other	**-**	-	-	-
TOTAL	**18,000**	**-**	**-**	**18,000**
TOTAL PARTICIPANT CONTRIBUTION				
Cash contributions	**4,116,203**	4,925,750	47,994,081	57,036,034
In-kind contributions				
- Salaries	**8,022,998**	8,461,405	36,313,593	52,797,996
- Other	**3,340,595**	4,623,704	14,784,351	22,748,650
TOTAL	**15,479,796**	**18,010,859**	**99,092,025**	**132,582,680**
TOTAL COMMONWEALTH CONTRIBUTIONS				
	2,852,000	**8,530,000**	**34,256,000**	**45,638,000**
TOTAL CONTRIBUTIONS				
Cash contributions	**6,968,203**	13,455,750	82,250,081	102,674,034
In-kind contributions				
- Salaries	**8,022,998**	8,461,405	36,313,593	52,797,996
- Other	**3,340,595**	4,623,704	14,784,351	22,748,650
TOTAL	**18,331,796**	**26,540,859**	**133,348,025**	**178,220,680**

15 Remuneration of auditors

During the year the following fees were paid or payable for services provided by the auditor of the Company:

	2015 $	2014 $
PwC		
AUDIT SERVICES		
Audit and review of financial statements	47,777	40,170
Agreed-upon procedures	6,000	-
TOTAL REMUNERATION FOR AUDIT SERVICES	**53,777**	**40,170**
OTHER SERVICES		
Compilation of financial statements	7,140	7,140
TOTAL REMUNERATION FOR OTHER SERVICES	**7,140**	**7,140**
TOTAL REMUNERATION OF PwC	**60,917**	**47,310**

16 Commitments for expenditure

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

- Funding obligations in relation to the appointment of research staff to address research areas that are relevant to the Company's obligations under the terms of the Commonwealth Agreement. The sum of the cash obligations is $6,414,547 (2014: $9,075,791).
- Research projects to the extent of cash $7,620,443 (2014: $7,935,829) subject to satisfactory performance as evaluated on a 3 monthly basis.
- Funding obligations for the secondment of employees to provide services to the Company for the period to 30 June 2020. The total sum of the obligations are $1,358,060 (2014: $1,629,672), dependent upon satisfactory performance by the secondees, assessed annually.

	2015 $	2014 $
Payable within 1 year	3,783,706	6,375,172
Payable greater than 1 year but less than 5 years	11,609,344	11,994,508
Payable greater than 5 years	-	271,612
TOTAL COMMITMENTS	**15,393,050**	**18,641,292**

17 Contingencies

At balance date the entity had the following contingent liability:

Under the terms of the Participants Agreement entered into by the Company on 6 July 2011, certain Participants, who are not shareholders of the Company, have agreed to make defined contributions (both cash and in-kind) to the Company in return for an interest in any intellectual property and income from commercialisation arising from the projects to which the Company applies the relevant contributions.

At balance date, the interest of Participants, other than shareholders, in any intellectual property and income from commercialisation arising from projects funded by the Company is calculated to be 17.05% (2014: 16.46%) based on total contributions, both cash and in-kind, from the inception of CRC CARE in 2005.

18 Related party transactions

(A) RESEARCH AND CONSULTANCY SERVICES

The Company engages related parties that are either shareholders and/or Participants to carry out research activities funded by the Company.

The Company also, on occasion, engages related parties to provide consultancy services to the Company.

The Company's commitments in relation to research and consultancy services provided or to be provided by Participants are included in note 16.

(B) MANAGEMENT SERVICES

Subsequent to the move of the operations of CRC CARE to the University of Newcastle, the Managing Director is engaged via a secondment agreement from the University of Newcastle, a Participant. The agreement provides for the Managing Director to act as a Director of the Global Centre for Environmental Remediation ("GCER") for 20% of his time. The balance of the Managing Director's time remains dedicated to the Company.

The Company has appropriate governance protocols and appropriate delegation of operational duties to deal with this relationship.

(C) IN-KIND TRANSACTIONS

The Company receives in-kind contributions, both staff and non-staff from Participants and applies these contributions to assist related parties to carry out research contracts entered into with the Company. During the year ended 30 June 2015 staff and non-staff in-kind contributions from Participants totalled $11,363,593 (2014: $13,085,108).

19 Subsequent events

No matter or circumstance has occurred subsequent to year end that has significantly affected, or may significantly affect, the operations of the Company, the results of those operations or the state of affairs of the Company or economic entity in subsequent financial years.

20 Economic dependency and continuance of operations

The Company depends upon continued support from Participants and the Commonwealth of Australia for its ongoing operations. During the period ending 30 June 2015 approximately 59% (2014: 37%) of the Company's cash contributions of $6,968,203 (2014: $13,455,750) was sourced from Participants and 41% (2014: 63%) from the Commonwealth of Australia.

21 Cash flow information

Reconciliation of net cash flows from operating activities to operating (loss) profit after income tax

	2015 $	2014 $
Operating (loss) profit for the year	(559,809)	-
Interest	(119,693)	(182,068)
Change in operating assets and liabilities:		
Decrease in trade and other receivables	95,115	1,827,894
(Increase) in prepayments	(20,294)	(129,409)
Decrease in deferred tax assets	39,750	-
Increase in payables	583,593	736,127
(Decrease) increase in provisions	(63,317)	47,603
(Decrease) increase in accrued expenses	(839,930)	386,641
(Decrease) in deferred revenue	(3,978,031)	(1,372,156)
NET CASH INFLOW FROM OPERATING ACTIVITIES	**(4,862,616)**	**1,314,632**

CRC CARE Pty Ltd
Directors' declaration
30 June 2015

As stated in note 1(a) to the financial statements, in the Directors' opinion, the Company is not a reporting entity because there are no users dependent on general purpose financial reports. This is a special purpose financial report that has been prepared to meet *Corporations Act 2001* requirements.

The financial report has been prepared in accordance with Accounting Standards and mandatory professional reporting requirements to the extent described in note 1.

In the Directors' opinion:

(a) the financial statements and notes set out on pages 4 to 25 are in accordance with the *Corporations Act 2001*, including:
   (i) complying with Accounting Standards and other mandatory professional reporting requirements as detailed above, and the *Corporations Regulations 2001;* and
   (ii) giving a true and fair view of the entity's financial position as at 30 June 2015 and of its performance for the financial year ended on that date; and

(b) 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 Directors.

Dr Peter Jonson
Chairman

Prof Ravi Naidu
CEO & Managing Director

30-10-2015

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Independent auditor's report to the members of CRC CARE Pty Ltd

Report on the financial report

We have audited the accompanying financial report, being a special purpose financial report, of CRC CARE Pty Ltd (the company), which comprises the statement of financial position as at 30 June 2015, the statement of comprehensive income, statement of changes in equity and statement of cash flows for the year ended on that date, a summary of significant accounting policies, other explanatory notes and the directors' declaration.

Directors' responsibility 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 is necessary to enable the preparation of a financial report that is free from material misstatement, whether due to fraud or error.

Auditor's responsibility

Our responsibility is to express an opinion on the financial report based on our audit. We conducted our audit in accordance with Australian Auditing Standards. Those standards require that we comply with relevant ethical requirements relating to audit engagements and plan and perform the audit to obtain reasonable assurance whether the financial report is free from material misstatement.

An audit involves performing procedures to obtain audit evidence about the amounts and disclosures in the financial report. The procedures selected depend on the auditor's judgement, including the assessment of the risks of material misstatement of the financial report, whether due to fraud or error. In making those risk assessments, the auditor considers internal control relevant to the entity's preparation and fair presentation of the financial report 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 entity's internal control. An audit also includes evaluating the appropriateness of accounting policies used and the reasonableness of accounting estimates made by the directors, as well as evaluating the overall presentation of the financial report.

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

Independence

In conducting our audit, we have complied with the independence requirements of the *Corporations Act 2001*.

PricewaterhouseCoopers, ABN 52 780 433 757
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Independent auditor's report to the members of CRC CARE Pty Ltd (continued)

Auditor's opinion

In our opinion, the financial report of CRC CARE Pty Ltd is in accordance with the *Corporations Act 2001,* including:

(a) giving a true and fair view of the company's financial position as at 30 June 2015 and of its performance for the year ended on that date; and

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

Material uncertainty regarding continuation as a going concern

Without modifying our opinion, we draw attention to Note 1 in the financial report, which indicates that the company has a deficiency of capital and reserves of $559,796, and a working capital deficiency of $642,127 as at 30 June 2015. As a result, the continuing viability of the company and its ability to continue as a going concern and meet its debts and commitments as they fall due are dependent upon the Company being successful in receiving the continuing support of the Participants and the Commonwealth of Australia and negotiating additional funding and getting agreement to bring agreed funding forward. These conditions, along with other matters set forth in Note 1, indicate the existence of a material uncertainty that may cast significant doubt about the company's ability to continue as a going concern and therefore, the company may be unable to realise its assets and discharge its liabilities in the normal course of business and at the amounts stated in the financial report.

Basis of accounting and restriction on distribution and use

Without modifying our opinion, 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 report is intended solely for the members of CRC CARE Pty Ltd.

PricewaterhouseCoopers

PricewaterhouseCoopers

MT Lojszczyk
Partner

Adelaide
30 October 2015

CRC CARE PARTNERS

Agilent Technologies Australia Pty Ltd

Australian Contaminated Land Consultants Association Incorporated

Australian Institute of Petroleum Ltd

BHP Billiton Iron Ore Pty Ltd

CH2M HILL Australia Pty Ltd

ChemCentre (WA)

Chevron Australia Pty Ltd

CSIRO

Curtin University

Department of Defence

Department of Environment and Resource Management (Queensland)

Department of Industry, Innovation and Science – National Measurement Institute

Environment Protection Authority (SA)

Environment Protection Authority (Victoria)

EthicalChem

FibreCell Australia Pty Ltd

GHD Pty Ltd

HLM Asia Group Limited

JBS&G Pty Ltd

Royal Melbourne Institute of Technology (RMIT)

Southern Cross University

Technological Resources Pty Ltd (Rio Tinto)

University of Newcastle

University of Queensland

University of South Australia

University of Technology, Sydney

University of Western Sydney

WA Department of Environment Regulation

CRC CARE
A safer, cleaner environmental future

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