Sustainable Communities and Waste

National Environmental Science Program

National Environmental Science Program
Sustainable Communities and Waste Hub Research Plan 2021

Introduction

The National Environmental Science Program

The National Environmental Science Program (NESP) is a long-term commitment by the Australian Government to environment and climate research.

The first phase of the NESP invested over $145 million (2014-15 to 2020-21) into 6 research hubs and emerging priority research projects. The second phase will invest $149 million (2020-21 to 2026-27) into 4 new research hubs.

The program:

- provides evidence for the design, delivery and on-ground outcomes for environmental programs

- helps decision-makers, including from Indigenous communities, build resilience

- supports positive environmental, social and economic outcomes.

More information on the NESP is available at http://www.environment.gov.au/science/nesp.

Hub role

The Sustainable Communities and Waste (SCaW) Hub is a consortium comprising six world-class research institutions led by University of NSW Sydney (UNSW), and including the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Monash University (Monash), the University of Tasmania (UTAS), Curtin University (Curtin) and Swinburne University of Technology (Swinburne).

Under the auspices of the Department of Agriculture, Water and Environment (DAWE), the Hub is a space to collaborate for academics, government, industry, and the community with the shared objective of enhancing environmental outcomes and reducing negative impacts on the environment and communities.

Our research agenda will be codesigned with DAWE and our partners at all levels of government, industry, non-government organisations (NGOs), national associations and Indigenous and other community groups in urban, regional and remote Australia.

Our vision is for:

- a transition to healthier, resilient and more prosperous urban, regional, and Indigenous communities

- innovative, participatory, and circular-based supply-chains transforming waste materials via new science to form the foundation of scalable manufacturing solutions

- improving biodiversity and conservation outcomes through better management of waste and pollution, behaviour change and connecting people to the environment

- improving human health and wellbeing and the liveability of our cities and regions

- embracing reconciliation and greater caring for our unique ecosystems by working with our First Peoples to build enduring relationships and sustainable communities

- increased prosperity by creating jobs and rebuilding Australia's manufacturing capacity.

Purpose of Research Plan

This first year Research Plan (RP1) was developed in consultation with DAWE and other key stakeholders.

The purpose of RP1 is to outline:

- the research priorities the Hub is funded to investigate, including those related to the cross-cutting mission the Hub is to lead
- the research projects that will address these priorities
- how the research projects will be codesigned, implemented and delivered with partner research users
- how the outputs of the research will be communicated and brokered to key stakeholders
- how the impact of the research will be measured
- how hubs will work collaboratively.

Research prioritisation	Codesign	Research delivery	Knowledge brokering & communication	Measuring impact

RP1 also provides detail on the management and governance of the Hub, including outlining the broader funding profile, key staff and research organisations, and the risks needing to be monitored to ensure success.
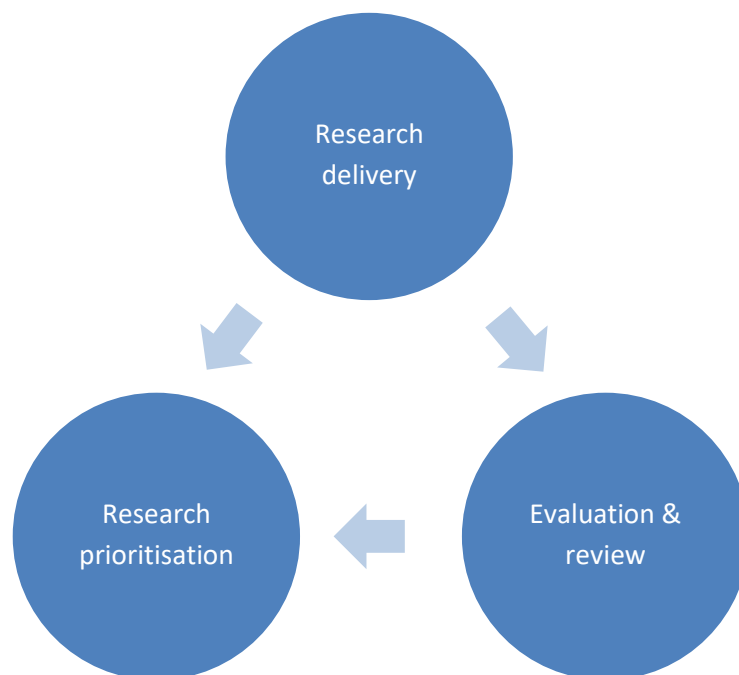
Research

Research priorities

The SCaW Hub is committed to a body of activity that includes short and long-term research projects. Each activity year, DAWE will work with the Minister, the hubs and other key stakeholders through a codesign process to identify and refine research priorities and develop projects that align with these priorities.

This research prioritisation is a rolling process and key milestones in each activity year, like the Annual Progress Report and submission of each annual Research Plan, as well as continual dialogue with research users, including Indigenous communities will inform the process.

This ongoing consideration and evaluation of research outputs and impact undertaken in partnership with our research users, builds confidence in the performance of the Hub and the effectiveness of the program. It also provides the basis for the flexibility needed in the Hub to engage in new themes of research in an adaptive manner and ensures that the Hub's focus is fixed on the delivery of relevant and practical research within a solutions science frame.

Overall approach

Our Hub is a new consortium and our first year (RP1) will focus on eliciting and prioritising the research needs of DAWE and our partners and research users including state environment departments and authorities. At the commencement of our Hub, our priorities are strongly shaped by the research scope overview as expressed in our application (see schematic below). These research priorities are grouped into four impact priority areas and the Hub's waste impact mission. A draft list of DAWE's current research priorities can be found in Appendix 1. Through a codesign process with our research users, an updated list of priority research needs will be produced. These will continue to be refined with our research users through the life of the Hub, and we will engage regularly with other NESP hubs to

coordinate efforts, especially through the missions. Ongoing engagement with DAWE at each stage will be paramount.

RP1 will work side by side with the Hub's agreed strategies for knowledge brokering, data management, Indigenous partnerships and communications. These strategies contain various guides and requirements, including on engagement, data management and knowledge product outputs which will all be adhered to. The requirements have been reflected in RP1 and in project proposals for each Impact Priority area.

IP1: Sustainable people-environment interactions (led by Monash, Swinburne and UTAS)

Research in IP1 will explore the liveability, sustainability and ecology of urban and regional communities to support policy, planning, design, and management to deliver ecological (e.g. biodiversity conservation), economic (e.g. green jobs), and social (e.g. health and well-being) benefits, and also enhance urban liveability, sustainability, and resilience. We will weave and integrate scientific, local and indigenous knowledge and methodologies to support transitions to a more inclusive, just and environmentally sustainable society. Our research will be guided by and inform Australia's Strategy for Nature 2019 - 2030 and the National Climate Resilience and Adaptation Strategy 2015 (soon to be updated in late 2021).

Our research priorities are:

1. supporting sustainable people-environment interactions in communities

2. increasing the liveability of urban and regional communities

3. managing people-species conflicts in urban settings

4. increasing the uptake of water sensitive urban design measures

5. understanding the benefits and complexities of urban greening measures

6. minimising urban heat island impacts

7. understanding and managing the effects of artificial light on species and ecological communities.

We will contribute to cross-hub mission priorities by:

8. implanting strategies to build resilience in urban wetlands

9. contributing information and developing strategies to improve biodiversity in urban green spaces.

IP2: Reduced impact of plastics and other materials (led by UNSW & Curtin)

Research in IP2 will be guided by and inform the National Waste Policy 2018 and the National Waste Policy Action Plan, among other national priorities. We will focus on local management solutions for both waste export banned, and other problematic, wastes. This includes plastics, glass and paper-based waste, as well as other waste materials, including low value plastics, mixed packaging materials, soft plastics, multilayered polymers, textiles, agriculture waste and photovoltaic waste. Embedded in circular economy principles, our research will explore product and waste recycling, reuse, repurposing, redesign and remanufacturing to increase manufacturing from recycled materials, thus boosting Australia's manufacturing sector, jobs, and overall prosperity. IP2 is focused on delivering improved economic, social and environmental outcomes to communities.

Our research priorities are:

1. reducing the impact of plastic and other material on the environment

2. assessing the effectiveness of using recycled material in new products and buildings

3. reducing impacts of waste fishing net on the marine environment.

We will contribute to cross-hub mission priorities by:

4. understanding the interactions between waste management methods and greenhouse gas emissions.

<u>IP3: Management of hazardous waste, substances and pollutants (led by CSIRO & Monash)</u>

Research in IP3 will minimise environmental and human health impacts through the assessment and prevention of contaminant releases, effective pollution management and appropriate reuse of chemical components and waste. We aim to understand points of entry and waste contributions to pollution in the Australian environment, including for emerging chemicals of concern. We will create new technologies to detect hazardous pollutants and to understand the modes of action, organism types, the challenges of mixtures, as well as acute and chronic effects.

Our research priorities are:

1. identifying effective and efficient management options for hazardous waste, substances and pollutants throughout their lifecycle to minimise environmental and human health impacts

2. identifying the entry of chemicals of concern in the environment including Per- and Poly-fluoroalkyl substances (PFAS) and heavy metals

3. understanding the impact of chemicals of concern on our natural ecosystems

4. developing methodologies for calculating toxicity or potency equivalence factors

5. identifying and developing contemporary environmental contamination detection technologies

6. developing and updating standards and frameworks for monitoring existing and emerging chemicals of concern, including baselines and trends for environmental levels

7. improving waste-water treatment technologies to reduce environmental impact.

We will contribute to cross-hub mission priorities by:

8. understanding the impact of chemicals of concern, waste and pollution on threatened and migratory species and ecological communities, and remediation options

9. evaluating the direct and indirect impacts of chemicals and pollutants on terrestrial and freshwater ecological communities.

<u>IP4: Improved air quality, forecasting and assessment (led by UTAS & CSIRO)</u>

Research in IP4 will explore how air quality in Australia, while generally good, continues to cause significant health impacts from bushfire smoke, planned burns, wood-heaters, and local industrial pollution. We will work with government agencies responsible for air quality, fire management and public health to identify research needs and generate information to inform decision-making. The effective dissemination of information to the public is also critical, as highlighted during the 2019/20 bushfires when the public was unable to interpret air pollution information nor understand the implications for their health.

Our research priorities are:

1. maintaining and improving air quality
2. transferring international air quality science to the Australian environment
3. identifying and developing effective new technologies aimed at reducing the concentration of air pollutants
4. evaluating local planning and zoning regulations to reduce air pollutants
5. developing and identifying tools for ambient air quality monitoring.

And we will contribute to cross-hub mission priorities by:

6. examining how a changing climate and emissions reduction measures will impact sources of air pollution and secondary pollutant formation.

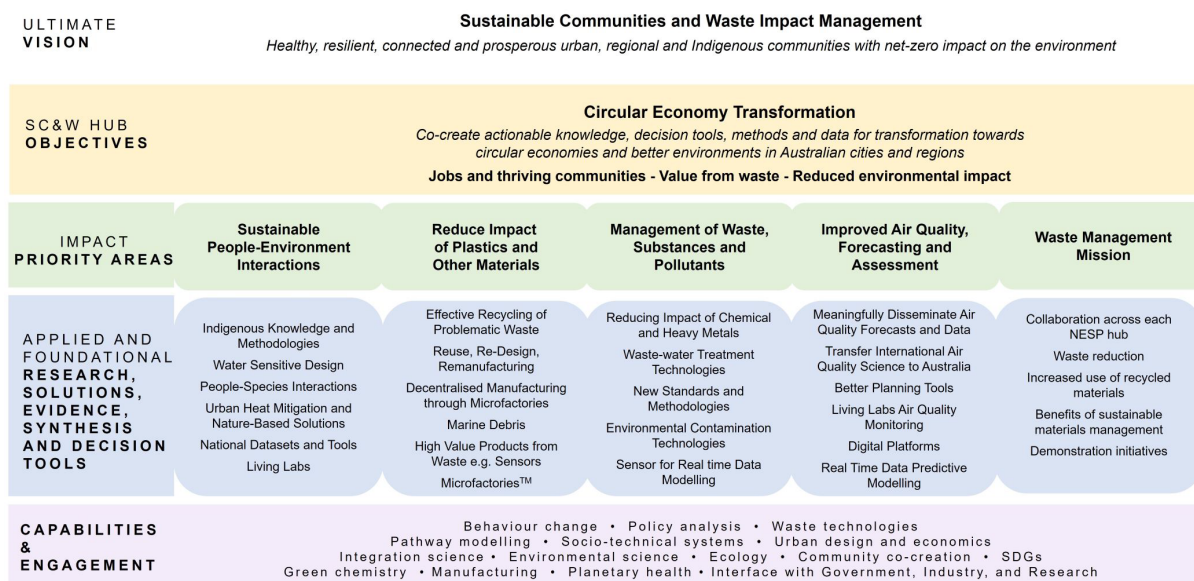IP5: Waste impact mission (led by CSIRO & Monash)

Research in IP5, under the 'waste impact management' mission, will deliver knowledge products for decision makers in policy and business and will facilitate linkages with the three other hubs. The initial research priorities stem from the Community Grants portal for the SCaW Hub and are packaged into four main areas of activities: metrics, data and indicators for sustainable materials management; codesign of demonstration projects in key target areas; economic and business models for circular economy; and identifying linkages, synergies and collaboration with the other three missions.

Our research priorities are:

1. innovative methods for reuse of materials, including proof of concept demonstration
2. identifying options for improved construction and demolition waste management
3. identifying baseline and ongoing recycling measures in the Australian economy
4. undertaking socio-economic analysis to assist with waste reduction and increased use of recycled materials
5. improving material sorting and re-processing
6. identifying options for the management and quantification of waste stockpiles.

There is a differentiation between the mission research and the role of the mission lead who will facilitate and coordinate whole of Hub contributions to and interactions with all cross-hub mission priorities.

Schematic showing Hub response to research priorities expressed in the SCaW Hub research scope.

ULTIMATE VISION	**Sustainable Communities and Waste Impact Management** *Healthy, resilient, connected and prosperous urban, regional and Indigenous communities with net-zero impact on the environment*				
SC&W HUB OBJECTIVES	**Circular Economy Transformation** *Co-create actionable knowledge, decision tools, methods and data for transformation towards circular economies and better environments in Australian cities and regions* **Jobs and thriving communities - Value from waste - Reduced environmental impact**				
IMPACT PRIORITY AREAS	**Sustainable People-Environment Interactions**	**Reduce Impact of Plastics and Other Materials**	**Management of Waste, Substances and Pollutants**	**Improved Air Quality, Forecasting and Assessment**	**Waste Management Mission**
APPLIED AND FOUNDATIONAL RESEARCH, SOLUTIONS, EVIDENCE, SYNTHESIS AND DECISION TOOLS	Indigenous Knowledge and Methodologies Water Sensitive Design People-Species Interactions Urban Heat Mitigation and Nature-Based Solutions National Datasets and Tools Living Labs	Effective Recycling of Problematic Waste Reuse, Re-Design, Remanufacturing Decentralised Manufacturing through Microfactories Marine Debris High Value Products from Waste e.g. Sensors Microfactories™	Reducing Impact of Chemical and Heavy Metals Waste-water Treatment Technologies New Standards and Methodologies Environmental Contamination Technologies Sensor for Real time Data Modelling	Meaningfully Disseminate Air Quality Forecasts and Data Transfer International Air Quality Science to Australia Better Planning Tools Living Labs Air Quality Monitoring Digital Platforms Real Time Data Predictive Modelling	Collaboration across each NESP hub Waste reduction Increased use of recycled materials Benefits of sustainable materials management Demonstration initiatives
CAPABILITIES & ENGAGEMENT	Behaviour change • Policy analysis • Waste technologies Pathway modelling • Socio-technical systems • Urban design and economics Integration science • Environmental science • Ecology • Community co-creation • SDGs Green chemistry • Manufacturing • Planetary health • Interface with Government, Industry, and Research				

Research projects

A list of research projects to be funded under the SCaW Hub can be found at Attachment A – Research projects.

Expected outcomes and outputs

The expected outcomes of the NESP are to produce research that:

- enhances our understanding of Australia's environment, climate and weather

- is communicated clearly to relevant stakeholders and the public

- is discoverable and accessible

- informs decision-making and addresses environmental priorities.

Hub outcomes and outputs

The SCaW Hub is enabling a systemic, transformative response to Australia's sustainability, waste and pollution challenges through the integration of key research fields, including ecology, engineering, environmental monitoring, public health, data science, technology, behavioural change, environmental economics, business innovation, and regional and urban planning. We work closely with all levels of government, private industry, NGOs and communities, including Indigenous to codesign research projects and cocreate knowledge products that will solve difficult problems that are impacting on the Australian environment and communities. Governance, community participation and Indigenous knowledge underpin our codesign approach. We are co-creating actionable knowledge, methods, tools and data for transformation towards circular economies and better environments in Australian cities and regions, across all states and territories.

<u>Our approach to codesign</u>

As outlined in the SCaW Knowledge Brokering Strategy, a key focus for the codesign is ensuring there is strong engagement with research users early in the program design, to understand their priorities and research needs; and ensure strong ongoing engagement with research users, particularly those who are partnering to deliver projects. Research users include government, industry and community stakeholders.

A codesign framework, being designed as a part of RP1 is centred around ensuring there are meaningful interactions with research users both at and beyond the design stage to ensure a solutions science focused so that outcomes delivered by Hub are useful, fit for purpose and address the needs of priority stakeholders, including DAWE.

To that end, the codesign framework will guide each IP area in developing a shared vision with research users and DAWE from the beginning and then working in partnership with them in a continuous collaborative effort, i.e. to also co-develop and then co-implement projects.

The SCaW Hub is a space to collaborate for academics, government, industry, and the community with the shared objective of enhancing environmental outcomes and reducing negative impacts on the environment and communities. A core focus of the codesign will be ensuring that through the SCaW Hub, opportunity is provided to learn from one another and work towards collective impact. Sharing knowledge and learnings, particularly through the blending of traditional knowledge with western science will be key to finding sustainable solutions that support Indigenous communities. In this way, SCaW will play an important role in helping research users navigate solutions to the challenges they are facing through a collaborative and partnership driven approach and through the provision of technical support and knowledge sharing. SCaW also presents an opportunity to showcase work already being done to inspire others.

The following box outlines our codesign shared values for the SCaW Hub:

SCaW Hub codesign shared values

- We embrace and display flexibility, adaptability, creativity, transparency, experimentation, curiosity.

- We respect for the needs of all research users and hub teams.

- We undertake active listening to understand the needs of research users and Hub teams to understand expectations and goals, identify synergies and opportunities that empower and build capacity, working together to find transformational solutions that address wicked problems.

- We are open and listen to the views of others - continually sharing knowledge as it evolves.

- We have a willingness to take 'smart risks' together to produce better research and make better decisions.

- We respect different knowledge and evidence systems - being mindful, giving the time and taking care in working across diverse backgrounds, experience, and knowledge.

- We have a willingness to work together on agreed plans to incorporate the key priorities and views of all actors involved.

- We apply adaptive processes that allow all actors to learn from mistakes and adapt to new research/ ways to address research user needs - failure is an important aspect of joint learning processes.

- We bring a 'solutions' science focus.

- We acknowledge that codesign occurs at all stages over the life of the Hub.

- We acknowledge that real codesign takes time and is built on trust between actors to support open, frank and effective communication.

We will connect science and learning across projects within our Hub, building on our extensive experience in delivering research with impact, such as using Living Laboratories to accelerate innovation. We will work with communities across Australian cities, regions and remote areas to form a network of 'living labs' as places where industry, community and researchers meet to test and demonstrate new ideas and prototypes of social and innovative solutions such as MICROfactorie™ technologies. We will promote a culture of experimentation and 'learning by doing' with our partners, using the living labs as 'safe places' for innovation in sustainability and waste management.

We will model scenarios of alternative sustainable and liveable futures, develop management and decision-support tools, prioritise issues and research needs, synthesise knowledge, and transfer international science to the Australian context.

We will work closely and collaboratively with other NESP hubs to achieve the goals of the NESP program "to support decision-makers from across the Australian community, including Indigenous communities, achieve positive environmental, social and economic outcomes".

Our Hub will ensure that the outputs we produce are delivered in partnership with research users to ensure they will be useful for and used by them. We will codesign research projects with relevant research users, including the format of products to facilitate their use through eliciting and prioritising research needs. We will coproduce research with the participation of research users where feasible and desirable.

Outcomes from RP1

- partnerships between the Hub and research users in DAWE and other partners

- partnerships between the Hub and indigenous communities

- expanded capacity to undertake applied and usable environmental research in Australia

- prioritisation of the research needs of DAWE, all levels of government, industry and communities

- increased understanding of the current state of knowledge, tools, and research projects in all our impact priority areas

- a research agenda to inform policy-making and decision-making, to improve environmental, economic, social and cultural outcomes related to sustainable communities and waste.

Outputs from RP1

- RP1 is focused on codesign to help build Research Plan 2 (RP2) in conjunction with DAWE and our partners

- a list of priority end-user research needs for the Hub

- synthesis reports of current knowledge, tools and research projects across our impact priority areas

- work under this year's research plan will produce project plans for inclusion in the 2022 Research Plan (RP2).

Collaboration and partnerships

The NESP encourages a collaborative, multi-disciplinary approach to environmental and climate research. Key to the success of the Hub will be the capacity to foster partnerships across all NESP hubs and with a wide range of decision makers across the Australian community, including Indigenous communities, to achieve positive environmental, social and economic outcomes.

The Hub is a consortium comprising six world-class research institutions led by UNSW Sydney. Our Hub leaders have a track record of collaboration with research programs and centres across Australia and around the world to foster science innovation and produce high quality science products.

Our collaborations and partnerships will be guided by all requirements within the Hub's four centralised strategies for data management, Indigenous partnerships, knowledge brokering and communications. We will not repeat here content from those strategies but reiterate the many requirements within these strategies apply to all Hub engagement and outcomes, with strategy lead involvement across project work.

<u>Cross hub waste mission and partnerships</u>

Our Waste Impact Mission Lead (Dr Heinz Schandl, CSIRO) will coordinate Hub and cross-hub activities for the 'waste impact management' functional mission to support decision-maker policy development, program management and regulatory processes in both marine and terrestrial environments. The Mission Lead is a key participant in the Hub leadership team and will regularly interact with mission leads from other hubs.

The role of the Mission Lead is threefold to (1) deliver mission oriented research to achieve an ambitious, time bound and measurable objective in inter and cross disciplinary partnership with key stakeholders and guided by DAWE; (2) develop an intellectual architecture and methodological apparatus for cross-hub interactions at the level of research priority linkages to address cross-hub deliverables identified by DAWE, as well as emerging cross-hub requirements; and (3) lead the mission research for the research priorities identified for IP5. Ideally the waste impact management mission objective will provide an umbrella for research activities in the SCaW Hub to enable a whole of Hub research deliverable at the end of NESP.

The Mission Lead will facilitate cross-hub interactions and internal alignment of research priorities with the needs of other NESP hubs and enable the delivery of research from all impact priority areas to contribute to other hub missions. In collaboration with the mission leads across the other three hubs, the SCaW Mission Lead will work with DAWE to formulate coherent strategic directions for the overall NESP program.

The Hub is already beginning to build collaborations with other NESP hubs and will actively participate in all cross-hub missions to achieve the goals of the broader NESP program. We intend to link key hub functions such as Mission Lead and knowledge brokering with equivalent roles in other hubs. The Mission Lead will coordinate connections with the missions of other hubs. We have several existing relationships across hubs, and two consortium members, CSIRO and UTAS, are part of all NESP hubs.

Existing relationships include:

- Melita Keywood is a researcher in the Climate Science Centre of CSIRO that hosts the NESP Climate Systems Hub and has begun discussion with the Climate Adaptation

Mission Lead (Sarah Boulter) and Climate System Hub leader (Simon Marsland) to about potential collaborations around air quality and climate change.

- Dave Kendal (Knowledge Broker) was on the Threatened Species Scientific Committee for four years, when it was chaired by Helene Marsh, Threatened Species Mission Lead for the Resilient Landscapes Hub.

- Dave Kendal was a researcher in the previous NESP Clean Air and Urban Landscapes (CAUL) Hub that completed several projects on threatened species in cities and the multiple benefits of urban greening and maintains close working relationships with many CAUL researchers.

- Dave Kendal is in the same UTAS department (Geography, Planning and Spatial Sciences) as members of the Climate Systems Hub (Rebecca Harris) and the Resilient Landscapes Hub (Vanessa Adams) and has started discussion on potential cross-Hub opportunities. There are some logical collaborations that could emerge here around community benefits of ecological restoration (Resilient Landscapes) and urban heat (Climate Systems).

- Joanna Vince was a researcher in the previous NESP Marine Hub and completed a project on Microplastics in the Australian Marine Environment with Professor Marcus Haward (IMAS) and maintains close working relationship with many other Marine Hub researchers.

- Joanna Vince is a member of the CSIRO Marine Debris team and she has collaborated with Dr Britta Denise Hardesty and Dr Chris Wilcox on numerous projects including co-supervision of PhD students.

- Monash University is a partner in the Climate Systems Hub.

External researchers and subcontractors

The Hub, through its universities and CSIRO, links with leading external researchers and universities globally. Hub partners also have research and development (R&D) capability and connections – for example Water Research Australia who link across all water utilities in Australia and their associated researcher cohorts. Such linkages will be brought to bear on Hub and other NESP projects of scale and complexity where capability is not housed within hub partners.

The Hub has already established relationships with key external researchers, including Cathy Oke, Melbourne Enterprise Senior Fellow in the Connected Cities Lab at the University of Melbourne (and formerly CAUL Knowledge Broker), Gary Veale, Executive Director, Centre for Sustainability and Business at Melbourne Business School.

Several partner organisations have a strong track record in research, including the Royal Botanic Gardens Victoria, and the NSW Office of the Chief Scientist and Engineer.

Related research programs

The Hub will leverage existing relationships with a range of organisations including:

- The Centre for Air pollution, energy and health Research (CAR).

- CSIRO and health and environmental jurisdictions including the CSIRO/Bureau of Meteorology Smoke forecasting system (currently being run operationally for fire agencies in Victoria and NSW).

- The Darwin Living Lab - a 10-year initiative involves CSIRO, the Australian and Territory Governments and City of Darwin. Collaborating with UNSW, Charles Darwin University and UTAS, the Lab is testing and evaluating heat mitigation measures to improve Darwin's liveability.

- CSIRO has a national program of Missions related to plastics, critical energy metals, emissions issues, and organic waste. These are linked to government, industry and community interests, meshing strongly with the Hub vision.

- UTAS hosts the Healthy Landscape Research Group (HeaLa) that aims to understand the connections between the environment and human health - especially in the context of rural and regional areas and small cities. It uses that knowledge to drive and learn from local initiatives that will benefit health for Tasmanians and make Hobart a leading "healthy regional city". HeaLa is currently undertaking a range of projects on urban and regional microbiomes, the benefits of biodiversity and nature in small cities, the multiple social and health benefits of ecological restoration programs and community gardens, and dark skies conservation.

- Various centres of excellence across UNSW (a Hub partner) and in particular the UNSW Sustainable Materials Research and Technology (SMaRT) Centre and its MICROfactorie technologies.

- Monash has been the lead in the Cooperative Research Centre (CRC) for Water Sensitive Cities, which wound up in June 2021. The CRC's mission to make cities more water sensitive is continued through the establishment of the Water Sensitive Cities Institute, who is a SCaW Hub partner.

- Monash is leading an ARC Linkage Project on 'Measuring the benefits of reuse in the circular economy' in partnership with the National Association of Charitable Recycling Australia, who is also a SCaW Hub partner.

- Monash is leading the ARC Discovery Project: Household Innovation and the Transition the Low Waste City, which examines the potential of households to contribute as innovators in a low waste sustainability transition.

- BehaviourWorks at Monash has been collaborating since 2018 with Victorian and NSW-based policy partners to look at the issue of waste and how to encourage Australians to avoid, reduce, reuse and recycle waste and adopt circular economy approaches from a behavioural change perspective.

- Swinburne leads the ARC LEIF funded iHUB: A smart urban research-synthesis-engagement platform for decision making. The iHUB facility is an integrated digital infrastructure platform for built environment research, synthesis, and engagement, targeting a wide range of city stakeholders and research users previously constrained by bespoke data analytics and visualisation facilities. The iHUB has been developed in partnership with Curtain, Monash and UNSW.

- Swinburne leads the ARC Linkage Project 'A multicriteria design platform to facilitate active journeys'. The cross-disciplinary study works with industry and local government partners to combine key 'walk-quality' urban design factors: pedestrian accessibility, thermal comfort, pedestrian risk, and air quality, into a design decision platform to enable systematic evaluation of precincts and test 'what-if' future design scenarios. The project relates to IP1 and IP4.

Government, Industry and community partnerships

The SCaW Hub has over 100 government, industry, NGOs, Indigenous and community partners spanning all States and Territories, all levels of government, urban, regional and remote locations and representing a diverse collection of small and large enterprises working across all Hub priority areas.

Key partners include:

- State Environment Departments (Victoria Department of Environment, Land, Water and Planning, Western Australia Department of Biodiversity, Conservation and Attractions, South Australia Department for Environment and Water, Tasmania Department of Primary Industries, Parks, Water and Environment, NSW Department of Planning, Industry and Environment)

- Environment Protection Agencies (EPAs)

- State Health Departments (Australian Capital Territory (ACT), Tasmania (Tas), Western Australia (WA))

- Other state agencies (Waste Authority WA, Development WA, Melbourne Water, Royal Botanic Gardens Victoria)

- Local governments in capital cities (e.g., City of Melbourne, City of Fremantle, Perth City Council) and regional centres (York (WA), Launceston, Brighton (Tas), Ballarat, Newcastle)

- Aboriginal and Torres Strait Islander groups (Tasmanian Regional Aboriginal Communities Alliance (TRACA), Fisheries Research and Development Corporation Indigenous Reference Group, Dharriwaa Elders Group)

- Environmental NGOs (Conservation Volunteers Australia, Landcare Tasmania, the Tasmanian North East Bioregional Network)

- Industry Associations (Planning Institute Australia, Water Services Association of Australia, Nursery and Garden Industry Victoria, Australian Tyre Recycling Association, National Retail Association)

- Large enterprises (Veolia, Mirvac, Deloitte, Woolworths, Wesfarmers)

- Small-medium enterprises (Instyle, ACT Recycling, Expand Glass Technology, Tellus Holdings, Spark Furniture, Textile Recycling Australia, Viewco, Emdo, Resmed, OZ Minerals, ABC Civil Group, Native secrets)

Indigenous partnerships

Our Hub aims to create sustained resilient and strong partnerships with Indigenous Australians through Hub projects. We recognise this enables identification of areas and issues related to social, economic, cultural and spiritual significance to Indigenous communities. We also recognise the importance contribution codesigned research has towards reconciliation and to realise opportunities of mutual benefit to Indigenous and non-Indigenous research. The result is an advantage to Australia from both a research and social perspective.

Our Indigenous partnership approach seeks to facilitate appropriate participation by Indigenous people, groups, and communities when undertaking research activities. We will ensure compliance with Indigenous Cultural and Intellectual Property (ICIP) requirements. Our projects will seek to provide investment to enhance Indigenous research capability including in regional and remote Australia. Our approach embeds skilled transfer to Indigenous people but

also Indigenous people sharing traditional knowledge and skills about sustainable communities and waste management with non-Indigenous people. Throughout the life of this Hub we will foster increased cultural awareness between members of the Hub, the participating nodes, and the communities where we will be conducting our research.

Our Hub's Indigenous Partnerships Strategy outlines criteria the projects need to address to ensure appropriate engagement with Indigenous Australians, and the Three Category Approach we will use to assess each project's level of engagement with Indigenous Australians.

APPENDIX 1: DAWE draft priority/Impact Priority area mapping

Mapping of DAWE initial research priorities (April 2021) to SCaW Hub Impact Priority area capabilities

Division	Research need	Priority	Impact priority area
Environment Protection	An improved understanding of the current distribution and flow of substances of concern in materials and products in the Australian economy.	1	Hazardous waste (IP3)
Environment Protection	An improved understanding of how to identify contaminated waste materials processed at recycling facilities in Australia, and chemical emissions from these facilities.	1	Hazardous waste (IP3)
Environment Protection	An improved understanding of the best available technologies/best environmental practice for identifying and managing waste streams.	1	Hazardous waste (IP3)
Environment Protection	To assist in the development of front-end solutions - i.e. addressing plastic pollution at its source - a better understanding how product design can reduce the release of microplastics/microfibres into the environment and their degradation rates is needed.	2	Plastics (IP2)
Environment Protection	Assist in developing a recycling solution for agricultural plastics contaminated with pesticides.	3	Plastics/Hazardous waste (IP2/IP3)
Environment Protection	Improved understanding of the quantities, types and pathways of plastic which make their way into the environment across the supply chain.	3	Plastics/Waste mission (IP2/IP5)
Environment Protection	An improved understanding of plastic and microplastic pollution in terrestrial, freshwater and marine environments.	3	Plastics/ Waste mission / People-environment (IP2/IP5/IP1)
Environment Protection	Better understand the products available, the products and specifications demanded, where gaps between the two exist, and specific actions (technical/policy) required to close those gaps.		Plastics/ Waste mission (IP2/IP5)

Division	Research need	Priority	Impact priority area
Environment Protection	Air quality and climate change interactions for adaptation or mitigation responses.	2-3	Air quality/People-environment (IP4/IP1)
Environment Protection	How can we best ensure an awareness of air quality issues and engender an appropriate response.	1-4	Air quality/ People-environment (IP4/IP1)
Environment Protection	Quantification of the benefits of ozone layer recovery to Australia and Australians.		Air quality (IP4)
Parks Australia	Developing localised and targeted sustainable housing and infrastructure that suits the needs of remote Indigenous communities living in protected areas vulnerable to climate change.	2	People-environment /Cross-hub (IP1)
Parks Australia	Developing more sustainable and cost-effective waste management strategies to support climate change adaptation in protected areas and remote communities.		Waste mission/Cross-hub/People-environment (IP2/IP5)
Parks Australia	People and nature in Uluru-Kata Tjuta National Park.	1	Cross-hub/People-environment (IP1)
Parks Australia	Responding to climate change in Kakadu National Park.	1	Cross-hub/People-environment (IP1)
Biodiversity Conservation	Impacts of light pollution on protected wildlife and proposed mitigation measures - Idea sourced from migratory species section, but we'd like to explore extending it to terrestrial and freshwater species.	2	Cross-hub/People-environment (IP1)
Biodiversity Conservation	Assess wildlife (especially migratory birds and seabirds) exposure to and impacts of PFAS, particularly in Ramsar wetlands.	3	Cross-hub/Hazardous waste/People-nature (IP3/IP1)

Division	Research need	Priority	Impact priority area
Biodiversity Conservation	What are the ecological implications of pesticides?	3	Cross-hub/Hazardous waste/People-nature (IP3/IP1)
Climate Adaptation and Resilience	Down-scale climate models to urban environments.		Cross-hub/People-environment (IP1)
Environment Protection	Improved understanding of the environmental health of urban and inland rivers, including the types, distribution and sources of chemical contaminants, and the effectiveness of existing infrastructure/controls for safeguarding these habitats.	2	Cross-hub/Hazardous waste/People-environment (IP3/IP1)
Environment Protection	Information on the levels of chemical pollutants in the Australian environment. This information will provide a baseline for evaluating the effectiveness of future regulatory action to reduce chemical pollution. Information will also direct policy makers/regulators towards the chemicals of highest concern.	3	Cross-hub/Hazardous Waste (IP3)
Environmental Protection Reform	Information to support cost-benefit analyses of environmental policy and demonstrate the broader economic value of a healthy environment. This will provide evidence for regulatory impact statements relating to reform of the EPBC Act.	5	Cross-hub/Waste Mission (IP5)
Heritage, Reef and Wildlife Trade	A lack of understanding of the factors leading to successful rehabilitation / restoration of disturbed savanna landscapes in northern Australia, including quantified trajectories of ecosystem recovery and management interventions, is perpetuating poor environmental outcomes. Improved knowledge and understanding of these processes will greatly improve assessments of, and rehabilitation plans for, developments in northern Australia.	1-5	Cross-hub/People-environment (IP1)
Heritage, Reef and Wildlife Trade	Temporary waters constitute most Australia's inland aquatic ecosystems and are the receiving waters for most of the nation's mining operations. However, these ecosystems are poorly understood in relation to ecology and risks from contaminants. ANZG (2018) is incorporating	1	Cross-hub/Hazardous Waste (IP3)

Division	Research need	Priority	Impact priority area
	new guidance on managing water quality in temporary waters but key knowledge needs remain and are considerable.		
Heritage, Reef and Wildlife Trade	There is a need to better understand how to regulate industrial discharges using laboratory-based and other methods.		Cross-hub/Hazardous Waste (IP3)
Heritage, Reef and Wildlife Trade	Information on radionuclide transfer to wildlife in uranium mining environments of tropical northern Australia to better inform assessments of environmental radiation exposure risks from operating and rehabilitated sites. This will strongly complement a National Energy Resources Australia (NERA) project focussing on Australian arid environments (https://www.nera.org.au/NERA-projects/Radiological-Risk-Assessments#) and support the development of a national database of reference values for use by industry and regulators.		Cross-hub/Hazardous Waste (IP3)
Heritage, Reef and Wildlife Trade	Soil health. Identification of feasible and effective strategies to improve soil health for productivity, carbon sequestration, water use and water quality benefits.	2	Cross-hub/Hazardous Waste (IP3)
Heritage, Reef and Wildlife Trade	Improved risk assessment and management of pesticides and emerging pollutants; expansion of land uses such as banana farming.	2	Cross-hub/Hazardous Waste (IP3)
Heritage, Reef and Wildlife Trade	Marine debris – source control and mitigation actions.	2/3	Cross-hub/Waste Mission (IP5)
Parks Australia	Inventory - characterisation of values & benefits: Surveys to identify the distribution of natural, cultural and heritage values and pressures on these values to inform Australian Marine Park management and planning for marine parks, with a focus on critical knowledge gaps in priority areas in the Australian Marine Parks and in the Indian Ocean territories.		Cross-hub/People-environment (IP1)
Parks Australia	Improving management effectiveness: Designing methods and approaches for research and monitoring and implementation of monitoring programs for priority natural and cultural values, and social and economic benefits (i.e. those that are high value and at risk from pressures that		Cross-hub/People-environment (IP1)

Division	Research need	Priority	Impact priority area
	Parks Australia can generally manage) at a range of scales from site-level to across the parks network.		
Parks Australia	Ecosystem function, resilience, recovery, restoration, & adaptation: Effective environmental management requires understanding of the ecosystems being managed and how they function. Within this science need, the emphasis will be on addressing critical knowledge gaps about ecosystem composition and function that can directly influence the way management is undertaken on-ground.		Cross-hub/People-environment (IP1)
Biodiversity Conservation	Broad research that informs the implementation of the CMS Single Species Action Plan for Loggerhead Turtles in the Pacific (SSAP).		Cross-hub/People-environment (IP1)
Biodiversity Conservation	Broad research that informs the upcoming 5-year review for Recovery Plan for Marine Turtles in Australia.		Cross-hub/People-environment (IP1)
Biodiversity Conservation	Information to support policy advice, EPBC Assessments and management interventions for threatened and migratory seabirds. Information to support international legally binding obligations under JAMBA, CAMBA, ROKAMBA, CMS and EAAFP.		Cross-hub/People-environment (IP1)
Environment Protection	improved understanding of the current distribution and flow of substances of concern in materials and products in the Australian economy.	1	Waste Mission/Hazardous waste (IP5/IP3)
Environment Protection	Improved understanding of how to identify contaminated waste materials processed at recycling facilities in Australia, and chemical emissions from these facilities.	1	Waste Mission/Hazardous waste (IP5/IP3)
Environment Protection	Improved understanding of the best available technologies/best environmental practice for identifying and managing waste streams.	1	Waste Mission/Plastics (IP5/IP2)
Environment Protection	To assist in the development of front-end solutions - i.e. addressing plastic pollution at its source - a better understanding how product design can reduce the release of microplastics/microfibres into the environment and their degradation rates is needed.	2	Plastics (IP2)

Division	Research need	Priority	Impact priority area
Environment Protection	Agricultural plastics contaminated with pesticides currently cannot be recycled and are generally buried or burned by operators on site. To assist in developing a recycling solution for agricultural plastics contaminated with pesticides.	3	Waste Mission/Hazardous waste/Plastics (IP5/IP3/IP2)
Environment Protection	improved understanding of the quantities, types and pathways of plastic which make their way into the environment across the supply chain.	3	Waste Mission/Plastics (IP5/IP2)
Environment Protection	improved understanding of plastic and microplastic pollution in terrestrial, freshwater and marine environments.	3	Waste Mission/Plastics (IP5/IP2)
Environment Protection	Material Performance Standards: working with those who produce and demand recycled materials to better understand the products available, the products and specifications demanded, where gaps between the two exist, and specific actions (technical/policy) required to close those gaps.		Waste Mission (IP5)
Environment Protection	Information on the levels of chemical pollutants in the Australian environment. This information will provide a baseline for evaluating the effectiveness of future regulatory action to reduce chemical pollution. Information will also direct policy makers/regulators towards the chemicals of highest concern.	3	Waste Mission/Hazardous waste (IP5/IP3)
Environment Protection	Improved understanding of the environmental health of urban and inland rivers, including the types, distribution and sources of chemical contaminants, and the effectiveness of existing infrastructure/controls for safeguarding these habitats.	2	Cross-hub/Hazardous waste/People-environment (IP3/IP1)
Environment Protection	Understanding the distribution and impacts of antimicrobials in soils, and development/identification of appropriate control technologies. Information will support government decision making - prioritising antimicrobials for management, and implementing appropriate controls.	1	Cross-hub/Hazardous waste/People-environment (IP3/IP1)

Division	Research need	Priority	Impact priority area
Biodiversity Conservation	Further information on each Christmas Island (CI) listed species to update Conservation Advice and the Christmas Island Strategic Assessment For discussion: could this be a 2 part project? With the second part being build on the lessons learned on CI and apply them to other regions? How would we approach this and which regions are best suited? Out puts should be specific and practical.	2-3	Cross-hub/People-environment (IP1)