

National Environmental Science Program

Sustainable Communities and Waste Hub
research plan 2023 – Attachment B
project plans - IP2



Project IP2.02 – Reduced Impact of Plastics and Other Materials

Project type: Hub research project	
Project status: Existing project seeking amendment to budget	
Cross-cutting initiative:	Yes
Project start date: 01/07/2022	Project end date: 30/06/2026
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Project description

Project summary

The research from IP2 is seeking to reduce the impact of plastics and other waste materials by:

- a) Understanding Microplastics (IP2.02.01) and,
- b) Finding fit-for-purpose technological recycling solutions for regional and remote communities across Australia (IP2.02.02).

In RP2023 researchers will continue co-designing and start moving to co-implement with the Department, industry and community groups, including both Indigenous and government, building on the foundational work in RP2022. This will include:

- The development of a national protocol for measuring and monitoring microplastics, providing deeper insights for policy
- Understanding of the sources and generators of microplastics
- A national framework for identification and evaluation of fit for purpose technological recycling solutions for regional and remote communities
- Commencement of demonstration case study with a remote Indigenous community that will provide the *ground-truthing* for solutions and provide lessons learned and stories to build the capacity of other communities.

IP2 researchers are guided by national priorities "*The National Waste Policy 2018*" and the "*2019 National Waste Policy Action Plan*" and supported by further plans including modernisation of recycling and manufacturing capability; and sustainable protection of national materials supply (critical materials).

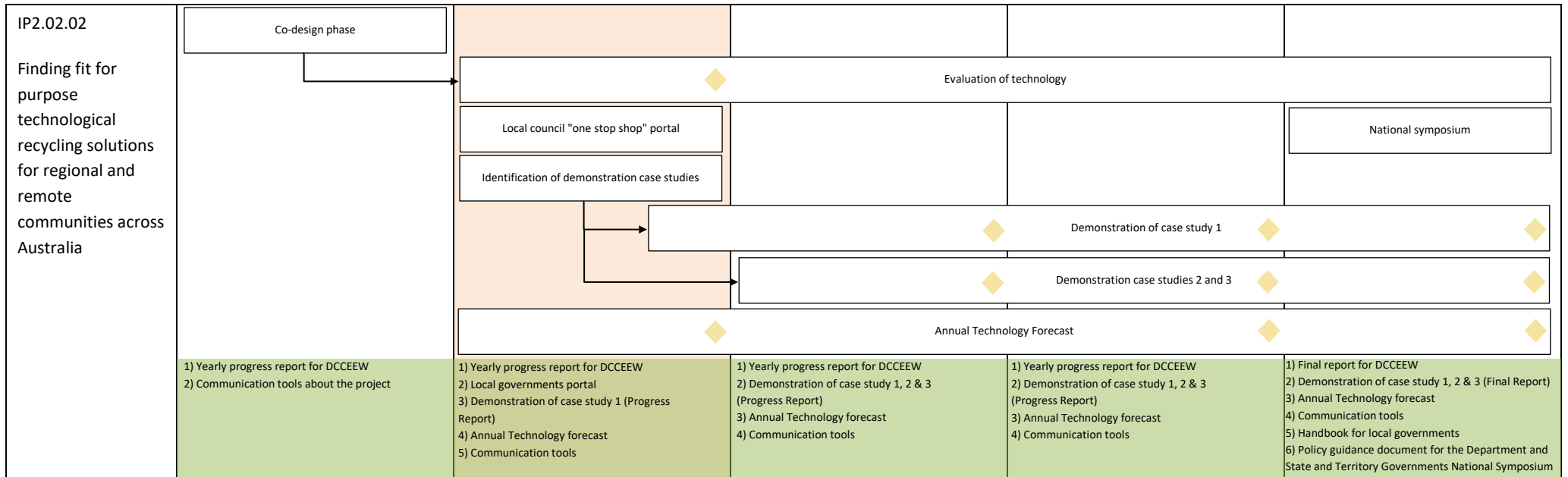
Project description

In RP2021 and RP2022, researchers in IP2 worked with research-users to co-design a series of impactful research projects under the 'Reduced impact of plastics and other materials' research theme for our SCaW Hub. These stakeholders and partners included the Department of Climate Change, Energy, Environment, and Water (the Department) and other research-users such as state environment departments, local government, NGOs, Indigenous groups, private sector, industry groups and other NESP hubs. In RP2022, two themes of focus emerged for researchers:

1. Understanding the impact of materials contributing to microplastics (plastics and tyres) and identifying potential solutions for management and control to reduce impact,
2. Finding "fit for purpose" technological solutions for regional and remote communities.

To address these issues, IP2 proposed two multi-year sub-projects in RP2022. In RP2023 the projects remain largely unchanged and are still following the plans outlined in RP2022. Due to the increase in focus on these themes, there is a request for an increase in resourcing to match the increase in scope.

IP2.02					
Project	RP2022	RP2023	RP2024	RP2025	RP2026
<p>IP2.02.01</p> <p>Understanding Microplastics (2022-2026)</p>	<p>Protocol and risk framework methodology development</p>				<p>Results of the improved or pivoted RP2025 interception pilots will be used to inform policy at various levels of jurisdiction</p>
<p>Ongoing co-design of RP2023</p>					
		<p>Fundamental analysis of Microplastics</p>	<p>Guidelines to recycle individual microplastic-producing precursor materials</p>	<p>Interception pilots will be designed to target the selected materials' recycling rates</p>	
		<p>Impact of Tyre Dust</p>	<p>Interception pilots will be initiated to combat tyre dust and microplastic problems</p>	<p>Interception pilots be reported and used to develop interception strategies based on whether strategy goals were met</p>	
		<p>Ongoing co-design of RP2024</p>			
				<p>A study on synthetic grass-based microplastic waste's composition, prevalence, and impact</p>	<p>Pilots for synthetic grass waste and recycling rate improvement interception</p>
<p>1) A progress report of findings to predict microplastic risk for EPBC Act-listed threatened species 2) A progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution 3) A "live" list of additives in plastics and types of plastics leads to harmful emissions, including micro/nano plastics</p>		<p>1) A preliminary report of findings to predict microplastic risk for EPBC Act-listed threatened species 2) A progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution 3) A final report on microplastic fundamentals 4) A preliminary report on tyre dust and recommendations for interception pilots 5) Factsheets and other communication tools about</p>		<p>1) Tyre dust interception pilot 2) Interception pilot plan for synthetic grass 3) A final report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution 4) Preliminary guidelines for recycling individual microplastic-producing precursor materials</p>	
				<p>1) Synthetic grass interception pilot 2) A final report on tyre dust including finding from the interception pilot 3) Interception pilot plan for microplastic-producing precursor materials 4) Updated research plan for RP2024</p>	
				<p>1) A synthesis report will be developed based on the previous year's work, outlining next steps 2) Factsheets and other communication tools about the project</p>	



IP2.02.01: Understanding microplastics (2022-2026)

The problem

Research on microplastics and their potential threats to ecosystems and humans is in its infancy and is complex - a lot remains uncertain. However, growing scientific evidence on the hazards of the uncontrolled, irreversible, and long-term ecological risks due to microplastics do exist for some coastal waters and sediments. Scientists predict that if emissions to the environment continue at the current rate or increase, ecological risks could be widespread within a century. A key issue highlighted by the Department and other research-users through the co-design activities in 2021 was the need for an improved understanding of the impacts of microplastics in Australia on the environment and species to guide policy and best practice management responses. In particular, the following priorities were identified:

- **Developing a national monitoring protocol** - Currently, no standards exist for sampling and testing microplastics. A nationally consistent monitoring system and national database for microplastic pollution are required to improve knowledge of the prevalence and impact.
- **Understanding best practice management for tyre dust and use of rubber crumb** – Improved understanding is required about the composition, occurrence, and fate of tyre particles in the environment, including the impact of factors such as tyre quality and road characteristics on tyre wear, particle generation and microplastic pollution from recycled rubber crumb. Research on these areas will help inform how to reduce microplastic emissions from tyres in Australia. This includes identifying best practices for the reuse and recycling of tyres considering the risk of microplastic pollution—for example, the use of rubber crumb in artificial sports turf.
- **Understanding microplastic risk for Environment Protection and Biodiversity Conservation (EPBC) Act listed threatened species** – Greater knowledge is needed about plastic waste characteristics (e.g. toxicity, colour, ability to fragment, density, format, composition, size) that increase the likelihood of negative impacts on marine vertebrates when ingested or entangled. A risk framework is required to build understanding related to plastic and microplastic pollution and be able to make predictions on microplastic risk for EPBC Act-listed threatened species.

Our response

The project seeks to address the concerns raised by councils, industry, governments and communities over microplastics and component materials to directly address gaps on the prevalence and impact of microplastic pollution. Over a five-year project, IP2 will undertake research to answer the specific questions raised by the Department and others regarding microplastics.

In the first year (2022), the focus is on developing a monitoring protocol for the systematic sampling, identification, and analysis of microplastics in a variety of environmental matrices (i.e. different environments, such as sand, soil and water), which is being undertaken through a co-design process and refined through RP2022 (currently underway). A broad set of stakeholders, including from peak bodies, local council associations and state governments will be engaged in the co-design process. The protocol will encompass primary (direct release) and secondary (fragmented from larger items) microplastics. Work will also commence to co-design, with the Marine and Coastal and Resilient Landscapes Hubs and key stakeholders, a methodology to develop a risk framework for understanding impacts to EPBC Act listed species by way of a cross-hub planning workshop with experts from relevant fields.

The following years (2023-2026) will tackle specific areas of concern for secondary microplastics raised by research-users, such as waste tyres, synthetic grass, stormwater sourced and marine debris. This list will be refined over time through co-design. Materials analysis, identification of control and management options and solutions to reduce risk, for example, through re-manufacturing of

materials or through providing alternatives, will be the focus to inform improved understanding of how to minimise impacts. Data will be populated into a national database being developed by the Department. Working with the Marine and Coastal Hub and Resilient Landscapes Hub and critical stakeholders, a species-microplastics risk framework will be developed and tested.

Given the significance of microplastics being found in coastal and marine environments, engaging with Indigenous Ranger groups and their communities will be undertaken over the life of this project. Where opportunity arises, working with Indigenous researchers to undertake aspects of the project will also be sought.

Data relevant for impact and measuring success will be shared in consultation with the Data Wrangler and Knowledge Broker.

Methodology

RP2022 Activities and methods

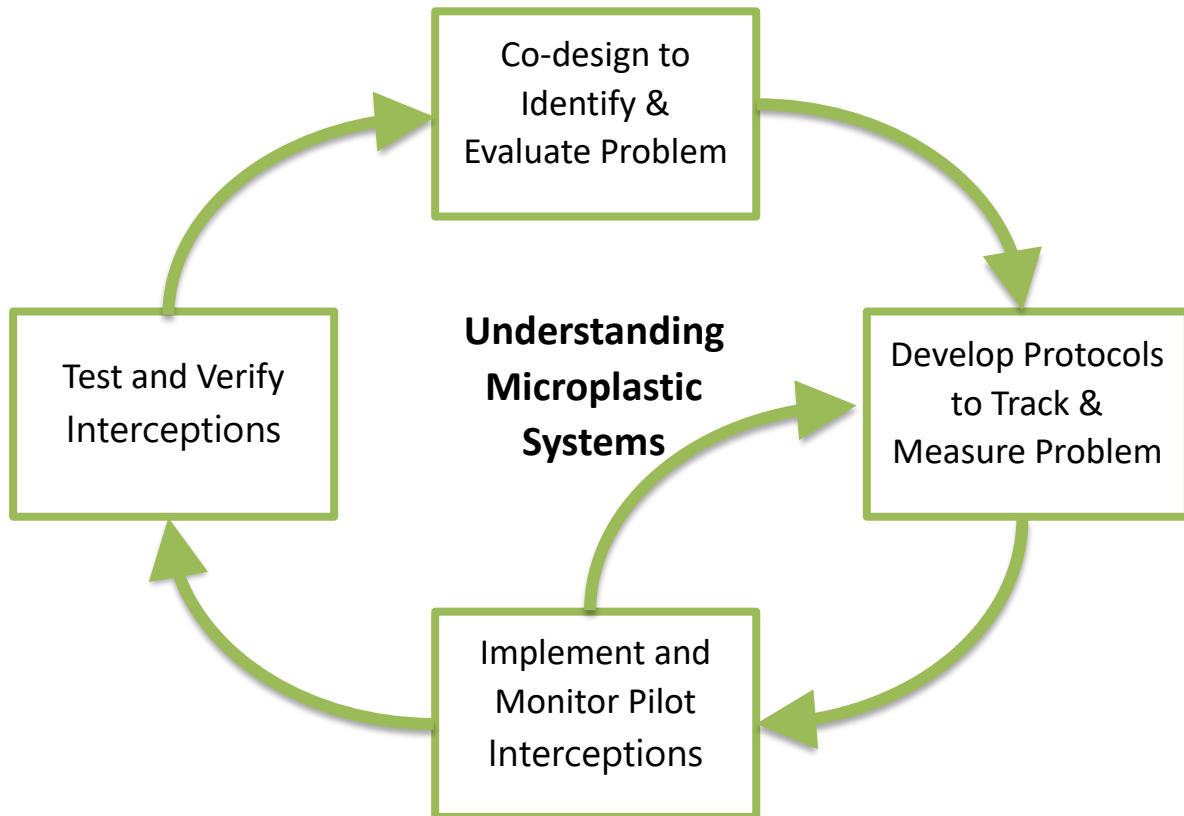
The first year of this project is divided into two target areas, namely sampling protocol development and further co-design to refine the project plan for the proceeding years.

Protocol and Risk Framework Methodology Development - Researchers have started conducting a literature survey, identifying gaps, and developing a national protocol to build a better understanding of the qualities of plastics and plastic items (e.g. toxicity, colour, ability to fragment, density, format, composition, size) that increase the likelihood of negative impacts. The literature survey will be completed in RP3 and will inform activities in 2023 and beyond.

RP2021, through the co-design process found there is no standardised protocol for sampling, extraction, and purification, qualitative and quantitative analysis of microplastics, with specific gaps on nano-plastics (NPs) smaller than 1µm. Researchers are currently investigating current best practices for detecting and quantifying micro/nano plastics in selected environmental matrices. The environmental matrices will be identified through the literature survey. Solutions will be ideated for investigation in RP2023.

To develop the protocol, researchers will identify sources (things that generate microplastics) and sinks (places where microplastics collect) of microplastics through literature survey and co-design with community and industry leaders impacted by microplastics. The identified sources may include tyre dust, and synthetic turf. The identified sinks, or hotspots, may include beaches, rivers/stormwater, agricultural land, playgrounds, landfill sites and waste storage areas.

The protocol will build off current practices from around the world, adapted and updated to the Australian context. The protocol will include representative sample designs, especially when sampling at beaches, also working with Indigenous communities to ensure sensitivities around land are accounted for.



Work will also commence to co-design, with the Marine and Coastal and Resilient Landscapes Hubs and key stakeholders, a methodology to develop a risk framework for understanding impacts of microplastics to EPBC Act listed species and to explore whether it can be extended to heritage sites.

Outputs

- 1) A progress report of findings to predict microplastic risk for EPBC Act-listed threatened species
- 2) A progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution
- 3) A "live" list of additives in plastics and types of plastics leads to harmful emissions, including micro/nano plastics. This list will be provided in a report format and hosted on the NESP SCaW Hub website for community consultation. (Live in this context refers to the continual update, refinement and revaluation of the materials listed through the duration of this multi-year project)

Outcomes and Impact

- The start of a national protocol for measuring and monitoring microplastics, providing deeper insights for policy

RP2023 Activities and methods

RP2023 will build upon the co-designed research plan developed in RP2022. RP2023 will address the need for understanding tyre dust and the compositions of microplastics through a literature review and materials analysis. From the learnings in RP2022 metrics such as a "Risk rating" and ranking tools based on parameters such as prevalence will be added to the live list of material additives.

Fundamental analysis of microplastics - The literature survey started in RP2 will be concluded to identify the current understanding of microplastic presence and impacts in Australian contexts. From this study, intervention points will be determined to study and then affect the impacts of these materials firstly. This survey's critical areas of understanding include the relative contributions of

primary (whole particles) and secondary (fragmented materials) to microplastic contaminations. Further investigation will seek to determine the changes in physical properties associated with virgin and waste plastics and their degradation in environmental conditions, be that by bio- or photo-degradational means.

Supporting this literature review and desk-top analysis, using materials samples collected from across a broad geographic scope nationally and from a cross-section of industries/ organisations that use plastics, textiles and tyres, this project will undertake materials characterisation using fit for purpose technology. Fundamental analytical techniques, such as Raman and Fourier transform infrared (FTIR) Spectroscopy, will be utilised, alongside thermogravimetric methods.

These experiments will identify the origin of microplastics in Australian environments and the environmental impacts of their characteristics, including additive profiles, colour, fragmentation pattern, density, format, composition, and size. This study will also explore the relative contribution of different plastic species to the broader microplastic issue. Finally, prominent microplastic precursors' waste life cycles will be modelled to determine critical points for hazardous material release and interception methods.

Impact of tyre dust - Research will be undertaken to understand the composition, occurrence and fate of tyre particles in the environment, particle generation and on microplastic pollution from recycled rubber crumb. This study will inform manufacturers and regulators of best practices for the reuse and recycling of tyres, considering the risk of microplastic pollution, such as the incorporation of rubber crumbs in artificial sports turf. Researchers will work collaboratively with IP3 linking research on harmful additives and materials with microplastics.

Unlike many simple microplastics, tyres, composed of vulcanised rubber and synthetic substitutes, incorporate large quantities of sulphurous and other additive compounds whose degradation is toxic toward many segments of Australian ecosystems. However, the single application of these materials makes them a strong candidate for nuanced recycling techniques, unlike microplastics which come from more diverse sources. Much like the above microplastics study, this research will be conducted through an initial literature survey of individual tyre components, an assessment of their cradle-to-grave life cycles, and the impact of the whole and fragmented waste materials on host ecosystems.

This study will identify common automotive tyres' wear resistance and fragmenting tendencies and characterise the tyre dust particles released throughout their product lifespans. Various materials testing techniques will investigate the rates and impacts of these patterns to identify steps toward mitigating microplastic release through engineering, substitutional, or regulatory means.

Synthetic grass - Planning and consultation will commence for intercepting an unresearched source of microplastic release. At the time of writing, synthetic grasses have been identified by the Department as a potential target material. Planning, including co-design and research will identify the typical components and diversity of these materials, the spread of their use nationally, and current trends in their waste disposal or recycling methods.

Microplastic risks to EPBC Listed Species - Working with the Marine and Coastal Hub and Resilient Landscapes Hub and critical stakeholders, a species-microplastics risk framework will be developed and tested.

Outputs

- 1) A preliminary report of findings to predict microplastic risk for EPBC Act-listed threatened species
- 2) A progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution
- 3) A final report on microplastic fundamentals

- 4) A preliminary report on tyre dust and recommendations for interception pilots
- 5) Factsheets and other communication tools about the project.

Outcomes and Impact

- The development of a national protocol for measuring and monitoring microplastics, providing deeper insights for policy
- Understanding of the sources and generators of microplastics.

RP2024 Activities and methods

A detailed study will be undertaken on synthetic grass-based microplastic waste composition, prevalence, and impact. At completion, suggestions identified through co-design for interception points will be given, from which pilot studies can be designed.

Interception pilots will be initiated to combat tyre dust and microplastic problems analysed previously. The goal of these studies will be to increase plastic recycling rates and prevent microplastic release into the environment.

Based on the previous microplastic study, a set of guidelines will be recommended to recycle individual microplastic-producing precursor materials.

Outputs

- 1) Tyre dust interception pilot
- 2) Interception pilot plan for synthetic grass
- 3) A final report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution
- 4) Preliminary guidelines for recycling individual microplastic-producing precursor materials

Outcomes and Impact

- The development of a national protocol for measuring and monitoring microplastics, providing deeper insights for policy
- Understanding of the sources and generators of microplastics, with domain knowledge of tyre dust.

RP2025 Activities and methods

Interception pilots for microplastics and tyre dust implemented in RP2024 will be reported and used to develop either enhanced or pivoted interception strategies based on whether strategy goals were met.

Pilots for synthetic grass waste and recycling rate improvement interception will be initiated based on the guidelines laid out in RP2024.

On-going co-design activities will inform the next trial. This will be co-designed with the other hubs and the Department to identify priorities.

From guidelines developed in RP4, interception pilots will be designed to target the selected materials' recycling rates.

Outputs

- 1) Synthetic grass interception pilot
- 2) A final report on tyre dust including finding from the interception pilot
- 3) Interception pilot plan for microplastic-producing precursor materials

4) Updated research plan for RP2026

Outcomes and Impact

- The development of a national protocol for measuring and monitoring microplastics, providing deeper insights for policy
- Understanding of the sources and generators of microplastics, with domain knowledge of tyre dust.

RP2026 Activities and methods

Results of the improved or pivoted RP2025 interception pilots will be used to inform policy at various levels of jurisdiction and, if successful, could be expanded to nationwide programs.

RP5 Interception pilots will be reported and assessed as to their efficacy. Based on this result, they may be enhanced, expanded, or pivoted to capture the optimal data applicable to the findings of investigations previous.

Outputs

- 1) A synthesis report will be developed based on the previous year’s work, outlining next steps.
- 2) Factsheets and other communication tools about the project.

Outcomes and Impact

- The development of a national protocol for measuring and monitoring microplastics, providing deeper insights for policy
- Understanding of the sources and generators of microplastics, with domain knowledge of tyre dust.

Linkages

Linkages to IP3 and IP5 have been outlined in the plan in previous sections.

This sub-project will work closely with the Marine and Coastal and Resilient Landscapes Hubs to understand the risk that microplastics poses to EPBC Act listed species and potentially heritage areas. Preliminary discussions have been held and work will continue under RP2022. The Resilient Landscapes Hub will also engage in the work relating to tyre dust given the potential impacts to ecosystems that arise. Potential opportunities for using Nature-based Solutions to address the impacts of microplastics and nanoplastics, e.g., via filter feeders in the coastal and marine environment will also be explored with both hubs.

The following are relevant excerpts from RP2022 and RP2021 of the MaC Hub.

2.2	Advancing national standards and best practice to monitor key marine values and pressures	This project aims to advance the establishment and use of national standards and best practices to monitor the condition status of priority values and pressures of Australia’s marine estate. We will achieve this by building on the national standards and best practice process developed in the previous NESP Marine Biodiversity Hub to produce three new national standards for monitoring (drop cameras, socioeconomic surveys of marine users, marine microplastics). We will also develop a practical implementation plan to embed the application of standards, with particular attention to inclusive and diverse approaches (e.g. engagement of community groups and Indigenous partnerships). The plan will set out a future path to develop, maintain and make available national standards; increase their uptake; and
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		assess effectiveness and impact as related to the delivery of priority monitoring activities.
1.18	Synthesis of current data on microplastics in SE Aust	Plastic pollution is pervasive in coastal environments globally and in Australia. Due to their small size, microplastics (pieces <5mm) are readily ingested by marine organisms and potentially accumulate across food webs, raising concerns for biota, ecosystem services and human health. Yet, to define guidelines and support policy actions that curb microplastic pollution, managers and decision-makers lack clear, synthesised information on this multifaceted issue, including on occurrence, sources, and pathways of microplastics in coastal and marine environments. Therefore, this project aims to produce a synthesis of current data on microplastics in South Eastern Australian coastal waters (i.e. South Australia, Victoria and New South Wales) and identify key knowledge gaps for the management of plastic pollution.

IP2.02.02: Finding fit for purpose technological recycling solutions for regional and remote communities across Australia

The problem

As defined using the Australian Statistical Geography Standard (ASGS) categorisation¹, regional and remote communities struggle with finding *fit for purpose* solutions to address fundamental waste problems. Regional and remote locations present several unique challenges in managing waste, dealing with seasonal weather-driven isolation, and a lack of connection to major roads or towns. In many cases, regional and remote areas often lack kerbside waste collection and access to recycling and re-manufacturing centres². There has been significant work undertaken previously by several organisations to understand the complexities of the challenges and make recommendations for how best to address them³.

¹ Refer <https://www.abs.gov.au/ausstats/abs@.nsf/mf/1270.0.55.005> for definition of regional and remote

² Refer <https://www.awe.gov.au/environment/protection/waste/how-we-manage-waste/recycling-modernisation-fund/supporting-waste-infrastructure-regional-remote>

³ Previous work includes Australian Local Government Association (2018) Submission to the Department of the Environment and Energy: In response to the review of the Product Stewardship Act. August 2018; Infrastructure Australia (2021) 2021 Australian Infrastructure Plan; Local Government Association of Queensland (LGAQ) (2021); Queensland Indigenous Waste Strategy: Respecting Country - A sustainable waste strategy for First Nations communities; NACCHO (2020) Submission to House of Representatives Standing committee on Industry, Innovation, Science and Resources into Australia's waste management and recycling industries. Submission Number 223. Downloaded 19 October 2021. Pp1-8; North Queensland Regional Organisation of Councils (NQROC) (2020); North Queensland Waste and Resource Recovery Strategy 2020-2030. October 22, 2020; Northern Territory Environment Protection Australia (NTEPA) (2015) Waste Management Strategy for the Northern Territory 2015-2022.; Productivity Commission (2021) Right to Repair – Draft Report; RDATN feasibility study: <https://www.rdatropicalnorth.org.au/about/initiatives/fnq-plastics-industry-proposal/>.

The Department has identified trialling regional and remote waste management solutions as a priority for the SCaW Hub to address. Parks Australia noted the impacts unmanaged waste is having in Commonwealth Managed National Parks, including the socio-economic challenges it creates for resident Indigenous communities and the resulting effects on well-being and the environment and the challenges in remote islands.

From the co-design process undertaken with other stakeholders in 2021, the following challenges were also identified concerning regional and remote communities and waste management:

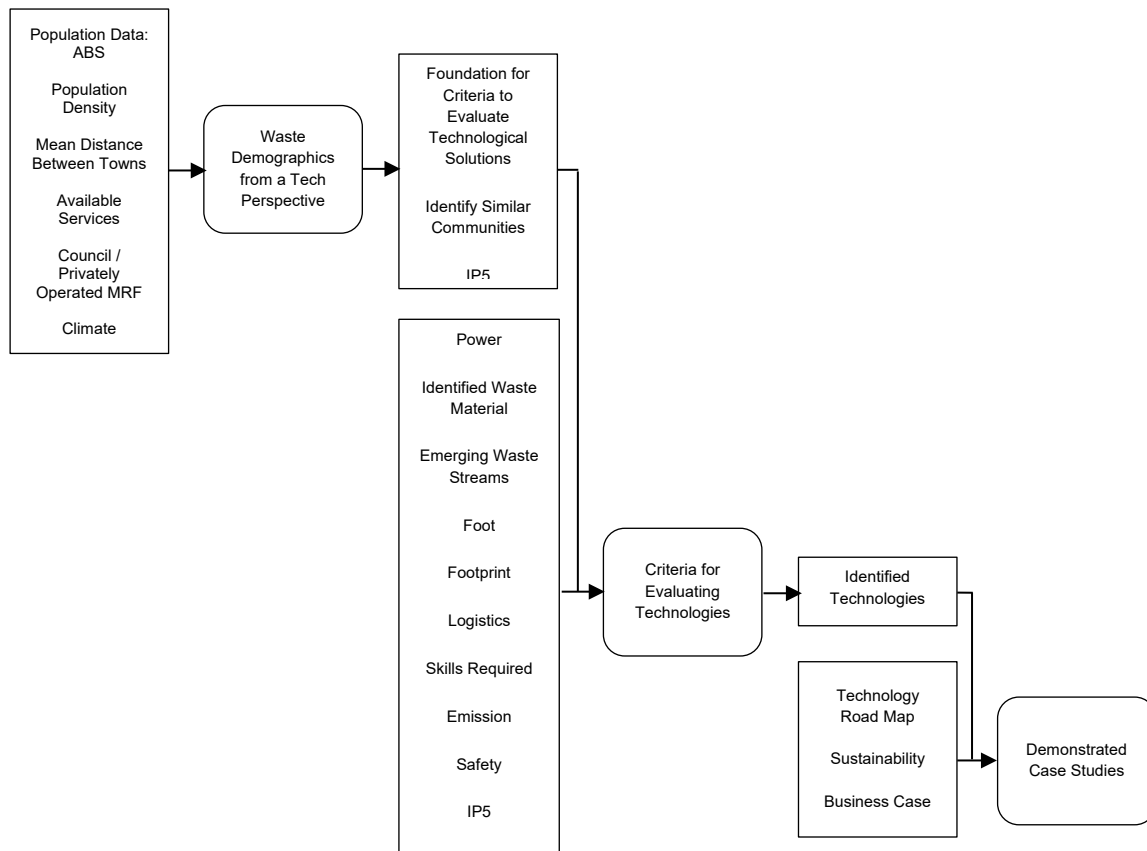
- Economies of scale and lack of existing infrastructure (lack of current recycling infrastructure as well as lack of transport and logistics) in regional and remote locations
- Lack of markets locally for waste materials
- Lack of incentives for recycling to reduce landfill
- Links between socio-economic problems experienced by some communities and the volume of waste in the community
- Lack of engineering or technical capability/jobs in communities, particularly for youth
- The complexity of different waste materials, e.g., solar panels, treated pine and agricultural waste, tyres, old batteries, metals, plastics, glass, and textiles

Our response

Building on the findings and using the recommendations from previous studies on how to address waste in regional and remote settings, this project seeks to identify and trial fit for purpose technological recycling solutions, utilising 'hub and spoke' models for remote/very remote, inner and outer regional communities across Australia.

We will evaluate and investigate suitable technologies available for regional and remote communities to cost effectively address waste management. A set of criteria will be co-designed with representative regional and remote communities, states, territories and federal government, and business and industry stakeholders to account for waste demographics (how waste relates to populations, densities and distributions in different geographic settings). The technologies will then be benchmarked against the agreed criteria. Three demonstration case studies over the life of the project will be undertaken, working with local communities (including Indigenous) in regional and remote settings with different waste demographics to identify and trial fit for purpose solutions. These case studies will include identification of materials supply networks to create sustainable businesses and technologies that provide local jobs and sovereign capability. Lessons learned, key findings and stories will be captured and shared on the Australian Circular Economy (ACE) Hub Portal (to be confirmed) or alternative. A 'one-stop-shop' solution will be provided for local communities through that portal to be able to provide guidance on available fit for purpose solutions that address their context and waste stream problems. Data relevant for impact and measuring success will be shared in consultation with the Data Wrangler and Knowledge Broker. Broad engagement across the SCaW Hub will be undertaken to consider findings, working closely over the life of the project with researchers in IP5 as they develop socio-economic metrics for sustainable solutions for regional and remote communities (IP5.02.03),

Methodology



RP2022 Activities and methods

A comprehensive co-design process is currently being undertaken with key stakeholders to **develop and define a waste demographics framework for regional and remote communities**. This process will include using interactive data interrogation tools to inform the development of a waste demographic framework and a series of workshops with key stakeholders from government, industry and regional and remote communities to understand priorities and challenges. An initial information primer will be prepared in advance of the co-design workshop. The findings will be summarised in a report to inform the metrics identified for undertaking a technology solutions evaluation.

Outputs

- 1) Yearly progress report for the Department and other research-users summarising progress and results. For 2022, this will include the waste demographic framework for regional and remote communities using the Australian Statistical Geography Standard (ASGS) categorisation. A summary of key findings from the co-design workshops with regional and remote communities will also be included. Account for networked governance in Indigenous communities.
- 2) Factsheets and other communication tools about the project.

Outcomes and Impact

- Identification of the needs of regional and remote communities and a framework to categorise similar communities in terms of demographics and needs/priorities.

RP2023 Activities and methods

Evaluation of technology - A co-design process will continue with key stakeholders to develop and define criteria (metrics) to evaluate available and emerging fit for purpose technologies. This will be informed by a literature review (looking at the academic- and industry- published expert reports) and stakeholder co-design workshops.

Design of a local council "one stop shop" portal - This will include a follow-up workshop with key stakeholders to present the result of the technology evaluation and identify how and what information should be presented that will be of most use (user requirements) in a public facing portal. Liaison with the ACE Hub will be undertaken to determine opportunities for inclusion of the information in the ACE Hub Portal, working with the Local Government Association to develop a sustainability strategy for it beyond the project. In addition, through creating a regional and remote 'community of practice', project stakeholders involved in the co-design process will be encouraged to share their solutions and technology they have identified for particular waste streams. This will also feed into the Annual Technology Forecast (below) and ongoing updates to the technology evaluation over the coming years.

Identification and commencement of demonstration case studies - Coming out of the co-design process from 2021 as well as in 2022, it is expected that 3 demonstration case studies will be identified, targeting firstly remote/very remote, then inner regional and outer regional communities, using the Australian Statistical Geography Standard (ASGS) categorisation. (Given the timing of this priority being identified towards the end of RP2021, a complete co-design process is continuing into RP2022 to select which communities to work with on demonstration projects).

Model recommendations from previous work to the trial hub will be implemented where appropriate. Otherwise, alternate models will be implemented based on community suggestions. Ongoing technical support will be provided to each group to assist in understanding the needs of the community to ensure that the solutions sought will be fit for their purposes and to support them through their implementation journey. At this early stage, lessons learned and stories relating to planning will be captured and included in consultation with the Data Wrangler. Demonstration case study 1 will commence in 2023 (location to be determined), with a focus on planning and enabling activities. Demonstration case studies 2 and 3 will be identified and preliminary co-design commence with communities.

Annual Technology Forecast – An Annual Technology Forecast will be prepared to summarise current and emerging technologies for the solutions being identified for the demonstration case studies and of relevance to other communities with similar waste demographics. It will also identify emerging waste streams that may become problematic.

Outputs

- 1) Yearly progress report for the Department and other research users summarising progress and results of the multi-year project. For 2023, this will include findings relating to:
 - Criteria (metrics) to evaluate technologies
 - A synthesis of existing waste demographic frameworks and metrics
 - Evaluation of technologies
 - User requirements for a *one-stop-shop* for local governments
 - Co-design outcomes
- 2) Demonstration of case study 1 - Remote Community Project Progress Report

- 3) Annual Technology forecast for evaluated technologies
- 4) Fact Sheets and other communication tools about fit for purpose technologies for different waste demographic settings

Outcomes and Impact

- A national framework for identification and evaluation of fit for purpose technological recycling solutions for regional and remote communities
- Provision of information for local governments to inform decision making around waste management in regional and remote communities
- Commencement of demonstration case study with a remote Indigenous community that will provide the *ground-truthing* for solutions and provide lessons learned and stories to build the capacity of other communities.

RP2024 Activities and methods

An update of the evaluation of technology will be undertaken for review by stakeholders.

Demonstration case study 1- remote implementation - Working with Indigenous community partners, support will be provided to implement the first demonstration case study. This could include assistance in business case development, feasibility studies, proposal preparation to access grants, and technical support and training to implement solutions. Lessons learned and stories will be captured and may be incorporated into the ACE Hub Portal or disseminated into a summary report for stakeholders. Materials supply networks will also be mapped for demonstration case study 1 to understand sources of materials and markets to sell products produced. A life-cycle assessment (LCA) of the carbon benefit/impact will be undertaken.

A co-design process to plan demonstration case studies 2 – inner regional, and 3 – outer regional will continue this year, with commencement of both projects towards the end of this year. The materials supply network mapping and a life-cycle assessment for demonstration projects 2 and 3 will also be undertaken.

Annual technology forecast - The Annual Technology Forecast will be refined and updated to reflect changes to current and emerging technologies for the solutions being identified for the demonstration case studies. It will also identify emerging waste streams that may become problematic for other regional and remote communities.

Outputs

- 1) Yearly progress report for the Department and other research users summarising progress and results.
- 2) Demonstration case study 1 - Remote Community Project Progress Report
- 3) Demonstration case study 2 – Inner Regional Community Project Progress Report
- 4) Demonstration case study 3 – Outer Regional Community Project Progress Report
- 5) Annual Technology forecast for evaluated technologies
- 6) Fact Sheets and other communication tools about on fit for purpose technologies for different waste demographic settings

Outcomes and Impact

- Provision of information for local governments to inform decision making around waste management in regional and remote communities.

- Practical demonstration case studies (communities) that will provide the *ground-truthing* for solutions and provide lessons learned and stories to build the capacity of other communities.

RP2025 Activities and methods

An update of the technology evaluation will be undertaken for review by stakeholders.

Demonstration case studies 1, 2 and 3 implementation - Learnings and feedback from demonstration case study 1 will continue to be captured. Working with community partners, support will be provided to implement the second and third demonstration case studies targeting different waste demographics, for inner and outer remote communities. This work could include assistance in business case development, feasibility studies, proposal preparation to access grants, and technical support and training to implement solutions. Lessons learned and stories will be captured and may be incorporated into the ACE Hub Portal or disseminated into a summary report for stakeholders.

Annual technology forecast – The Annual Technology Forecast will be refined and updated to reflect changes to current and emerging technologies for the solutions identified for the demonstration case studies. It will also identify emerging waste streams that may become problematic for other regional and remote communities.

Outputs

- 1) Yearly progress report for the Department and other research users summarising progress and results.
- 2) Demonstration case study 1 - Remote Community Project Progress Report
- 3) Demonstration case study 2 – Inner Regional Community Project Progress Report
- 4) Demonstration case study 3 – Outer Regional Community Project Progress Report
- 5) Annual Technology forecast for evaluated technologies
- 6) Fact Sheets and other communication tools about on fit for purpose technologies for different waste demographic settings

Outcomes and Impact

- Provision of information for local governments to inform decision making around waste management in regional and remote communities.
- Practical demonstration case studies (communities) that will provide the ground truthing for solutions as well as provide lessons learned and stories to build the capacity of other communities.

RP2026 Activities and methods

Ongoing support will be provided to all three demonstration case studies with learnings and feedback captured.

An update of the technology evaluation will be undertaken for review by stakeholders.

The Annual Technology Forecast will be refined and updated to reflect changes to current and emerging technologies for the solutions identified for the demonstration case studies. It will also identify emerging waste streams that may become problematic for other regional and remote communities.

A national symposium will be undertaken for local governments and other stakeholders to share the findings of the projects, experiences, and lessons learned.

Outputs

- 1) Final report for the Department and other research users summarising progress and results.
- 2) Demonstration case study 1 - Remote Community Project Final Report
- 3) Demonstration case study 2 – Inner Regional Community Project Final Report
- 4) Demonstration case study 3 – Outer Regional Community Project Final Report
- 5) Annual Technology forecast for evaluated technologies
- 6) Fact Sheets and other communication tools about on fit for purpose technologies for different waste demographic settings
- 7) Handbook for local governments on implementing fit for solutions for various waste streams identified
- 8) Policy guidance document for the Department and State and Territory Governments on addressing regional and remote waste management across Australia (developed in collaboration with IP5.02.03)
- 9) National Symposium

Outcomes and Impact

- Provision of information for local governments to inform decision making around waste management in regional and remote communities.
- Practical demonstration case studies (communities) that will provide the *ground-truthing* for solutions and provide lessons learned and stories to build the capacity of other communities
- Improved information to inform national and state, and territory policy responses.

Linkages

This project aligns with IP5.02.03, "*Governing Regional Community Based Resource Recovery and Circular Economy Initiatives*", and Impact Priority 3 "*Hazardous waste, substance and pollutants*". There are further linkages with IP1 "*Sustainable people-environment interactions*" due to the focus on local-scale community-based initiatives that will improve livelihoods. IP2 will work across the SCaW Hub with IP Leaders to ensure coordination and maximise opportunities where activities and budgets allow, particularly given its community-driven approach.

Is this a cross-hub project?

IP2.02.01: No

IP2.02.02: No

Does this project contribute to a cross-cutting initiative?

IP2.02.01: Yes

Preliminary conversations have been held to discuss the direct links for this project to the Marine and Coastal and Resilient Landscapes Hubs, primarily relating to IP2.02.01 on microplastics. There are strong linkages in working together to understand how materials such as plastics and tyres degrade over time and impact on ecosystems and threatened ecological communities and species. This research will contribute to delivering the *Threat Abatement Plan on the impacts of marine debris on the vertebrate wildlife of Australia's coasts and oceans*. This work will facilitate predictions on microplastic risks for species and potential heritage areas, listed in the *EPBC Act*.

Preliminary conversations have been held with the IP4 and the Climate Systems Hub and they have confirmed it will be of benefit through improved understanding of the additives and emissions associated with difficult to recycle materials as they degrade, and the emerging risks associated with air pollutants.

Other linkages relating to within the SCaW Hub are outlined above under the project description for each project.

IP2.02.02: No

Pathway to impact

Outcomes
<p>The ultimate outcome of this research over the course of the NESP program will be an increase in materials circularity in Indigenous, remote, regional and urban Australian communities.</p>
<p>Informing policy and frameworks</p>
<p>This outcome will contribute to the delivery of the National Waste Policy 2018" and the "National Waste Policy Action Plan, particularly the goals of "Helping to reduce total waste generated by 10% per person by 2030" and "Significantly increase the use of recycled content by governments, consumers and industry".</p>
<p>This new knowledge is expected to inform future policy discussion and considerations at all levels of government on addressing waste management, including microplastics in regional and remote communities and strengthen the capacity to implement fit for purpose solutions.</p>
<p>Community benefits</p>
<p>The research projects will identify ways in which local communities can benefit from regional technological solutions to transform waste materials into new products. The benefits may include local jobs, improved environment (understanding microplastics), and local education.</p>
<p>Economic Benefits</p>
<p>The project's outcomes will catalyse supply chains and create new markets. This work will lead to opportunities for Australian Indigenous, remote, regional and urban communities to embrace circular economy solutions to drive social and economic benefits.</p>
<p>Environmental Benefits</p>
<p>The project will advance recycling and plastic related policies, providing a framework to develop and promote new and sustainable national supply chains, reducing the impacts of waste materials subject to the export ban as well as the effects of microplastics on the environment. It will inform the Department's policy design and decision making via community co-designed solutions and on-ground success. The research will also provide innovative recycling solutions for waste streams, including plastics, tyres, textiles, and glass.</p>
<p>Partnerships & Collaboration</p>
<p>Building partnerships between SMEs, all levels of government and local indigenous and non-indigenous community groups through co-design and partner projects to reduce the impact of waste materials.</p>

Research-user	Engagement and communication	Impact on management action	Outputs
<p>IP2.02.01: Understanding Microplastics (2022-2026)</p> <p>Key partners are being identified through the RP2 process.</p> <p>Primary Research Users Include:</p> <p>Plastics, packaging and marine debris section, Biodiversity Conservation section, Heritage Reef and Oceans section (the Department), DPE NSW, Scape, Molycop 360, Sustainable Plastics Australia, Local Councils</p> <p>Ausmap, Total Environment Centre, EarthWatch Australia</p>	<p>Research-users have been engaged in the development and design of project and outputs through regular co-design workshops.</p> <p>Findings and outputs to be communicated via project workshops, project update emails and presentations.</p> <p>Key stakeholders, including EPD, will continue to be engaged through regular briefings to ensure alignment of workplans and outputs to ensure mutual benefits.</p> <p>Research outcomes will continue to be communicated through industry media, the SCaW Hub website, via social media and workshops and events.</p> <p>Researchers will continue to work closely with industry, scientific and regulatory bodies to meet the aims of the sub-projects.</p> <p>The researchers will work closely with the Knowledge Broker, Industry and Impact Manager, Data Wrangler, Senior Indigenous Facilitator and Communications and Media Manager of the SCaW Hub for capturing and transferring the knowledge created in this project.</p>	<p>Initial Research completed during RP2 will be used to direct operations including fundamental analyses of microplastics and their threat, as well as in-depth investigation into the impacts of tyre dust, synthetic grass, and the risks of microplastics toward EPBC listed species.</p>	<p>A preliminary report of findings to predict microplastic risk for EPBC Act-listed threatened species.</p> <p>A progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution.</p> <p>A final report on microplastic fundamentals.</p> <p>A preliminary report on tyre dust and recommendations for interception pilots.</p> <p>Factsheets and other communication tools about the project.</p>
<p>IP2.02.02 Finding Fit for Purpose Technological Recycling Solutions for Regional and Remote Communities Across Australia (2022 to 2026)</p>	<p>Co-design activities will continue and partnerships with local communities established to undertake demonstration case studies. Regular engagement will occur as a part of this process with partners. Regular update (monthly) engagements will occur with stakeholders involved in each</p>	<p>Results of early research will be used to conduct:</p> <p>Evaluation of technology</p> <p>Design of a local council "one stop shop" portal</p> <p>Identification and commencement of demonstration case studies</p>	<p>Yearly progress report:</p> <ul style="list-style-type: none"> • Criteria (metrics) to evaluate technologies • A synthesis of existing waste demographic frameworks and metrics • Evaluation of technologies • User requirements for a <i>one-stop-shop</i> for local governments

Research-user	Engagement and communication	Impact on management action	Outputs
<p>Key partners have been confirmed</p> <p>List includes:</p> <p>the Department - EPD, Parks Australia Representative local governments from regional and remote locations State and territory governments Regional Development Agencies Industry sectors (including manufacturing, agricultural and aquaculture) Business and private sector Investors</p> <p>Local communities (including Indigenous)</p>	<p>demonstration case study to build trust and rapport.</p> <p>Monthly update calls to the Department to report progress.</p> <p>The researchers will work closely with the Knowledge Broker, Industry and Impact Manager, Data Wrangler, Senior Indigenous Facilitator and Communications and Media Manager of the SCaW Hub for capturing and transferring the knowledge created in this project.</p>	<p>Annual Technology Forecast</p>	<ul style="list-style-type: none"> • Co-design outcomes <p>Demonstration of case study 1 - Remote Community Project Progress Report</p> <p>Annual Technology forecast.</p> <p>Fact Sheets and other communication tools about on fit for purpose technologies for different waste demographic settings.</p>

Indigenous consultation and engagement

Australian Aboriginal and Torres Strait Islander peoples have integral physical and cultural connections with land and sea environments and their sustained protection and care. However, waste streams such as plastics, tyres, glass, metal, textiles litter the landscape of regional and remote areas of Australia. Based on preliminary discussions during a 2-day workshop with Aboriginal businesses and communities in NSW and Western Australia in 2021, these waste streams are growing concerns to Traditional Owners.

In RP2021, preliminary discussions were held with an Aboriginal business from NSW and members from a community in Western Australia to gauge interest and support for working with IP2. During conversations with the members, such as the York Shire in Western Australia, Traditional Owners and members of the community raised their concerns about the challenges with waste management within their community and the opportunities they could see for developing jobs for young people through implementing community waste management programs to recycle and re-manufacture many types of waste such as plastics and tyres.

Due to Curtin University's staffing changes, our engagement with the York Shire community did not continue in RP2022. An Expression of Interest (EoI) process being developed by the Hub's Senior Indigenous Facilitator will allow this project to identify Aboriginal and Torres Strait Islander communities, businesses, and Indigenous researchers interested in engaging in the project in RP2022 and beyond as a part of our co-design. In particular, it is expected that the EoI process will help identify a community that could be the demonstration case study for trialing implementing technology solutions in a remote setting and those wishing to engage in the microplastics sub-project.

In 2023, the Hub will be developing an interactive visual dashboard of Indigenous research across Australia, led by the Senior Indigenous Facilitator. The dashboard will allow the capture and exploration of research relevant to the SCaW remit, including for this project to inform co-design activities for RP2022 and beyond. It is anticipated that this will assist in identifying existing or proposed research relevant to the project and communities affected by the study, providing an opportunity to collaborate with Indigenous researchers or build upon their work.

The project's research goals are aligned to the Environmental Science Program Indigenous partnership principles and the Hub's Indigenous Partnership Strategy, which include respect and mutual benefit, a right to Indigenous cultural and intellectual property, co-created research, Indigenous lead governance, and relationships-focused and an individual approach. The sub-projects described in RP3 sit in the *Scoping and Building* wedge of the *Partnering Cycle* (Figure 1 of the Indigenous Strategy).

We hope to initiate progress based on this framework by *identifying potential partners* (particularly Indigenous researchers and for communities to lead and participate in these discussions). We anticipate reaching the building relationships phase and that mapping and planning may be possible in 2022 but will likely occur in 2023.

Sub-Projects 1 and 2 fit into **Category 1 of the NESP Three Category Approach**. The goal in both cases is to co-design, collaborate on and communicate the outcomes from the research relating to microplastics and addressing regional and remote waste management, given its direct relevance to Indigenous communities. The 2022 component of the project will focus on the co-design aspect of the Category 1 Approach.

This project will draw upon the knowledge of project partners Curtin University and their Centre of Aboriginal Studies and Dr Arthur Wilson, a co-lead of this project. Dr Arthur Wilson will lead the co-

design activities with Indigenous communities, supported by the Hub's Senior Indigenous Facilitator, also from Curtin, Mandy Downing.

In addition, all project team members are required to undertake the Our Mob cultural awareness training and Indigenous Cultural and Intellectual Property (ICIP) True Tracks training to ensure engagement with Aboriginal and Torres Strait Islander communities is appropriate. The project activities will be co-designed and built on respect and mutual benefit.

Which Three-category approach the project meets	Codesign	Collaborate	Communicate
	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Project milestones

The following project milestones are specific to RP2023. Each subsequent research plan will elaborate on the annual milestones for multiyear projects.

IP2.02.01: Understanding Microplastics

Milestones	Due date	Responsible person
Milestone 1 – IP2.02.01 inception meetings/discussions	30 January 2023	Veena Sahajwalla / Arthur Wilson
Milestone 2 – A preliminary report on tyre dust and recommendations for interception pilots	30 June 2023	Veena Sahajwalla / Arthur Wilson
Milestone 3 – Preliminary Report of findings to predict microplastic risk for EPBC Act-listed threatened species	30 September 2023	Veena Sahajwalla / Anirban Ghose
Milestone 4 – A progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution	30 October 2023	Veena Sahajwalla
Milestone 5 – A final report on microplastic fundamentals	30 November 2023	Veena Sahajwalla / Anirban Ghose
Milestone 6 – Factsheets and other communication tools about the project	Ongoing (quarterly)	Veena Sahajwalla / Arthur Wilson
Milestone 7 – RP2023 Draft report submissions	30 December 2023	Veena Sahajwalla / Arthur Wilson

IP2.02.02: Finding Fit for Purpose Technological Recycling Solutions for Regional and Remote Communities Across Australia

Milestones	Due date	Responsible person
Milestone 1 – IP2.02.02 inception meetings/discussions	30 January 2023	Veena Sahajwalla / Arthur Wilson
Milestone 2 – Demonstration of case study 1 - Remote Community Project Progress Report	30 July 2023	Veena Sahajwalla / Arthur Wilson
Milestone 3 - Annual Technology forecast for evaluated technologies	30 September 2023	Veena Sahajwalla / Arthur Wilson
Milestone 4 - Fact Sheets and other communication tools about fit for purpose technologies for different waste demographic settings	Ongoing (quarterly)	Veena Sahajwalla / Arthur Wilson
Milestone 5 – RP2023 Draft report submission	30 December 2023	Veena Sahajwalla / Arthur Wilson

Data and information management

The information presented below is specific to RP2023. For each stage of a multiyear project, the table will be updated to reflect the specific outcomes.

Knowledge products, co-designed with stakeholders and the Hub knowledge broker, that are generated through the project phase may be made publicly available through the Hub website, and in accordance with the Hub data management and communications strategies, and subject to ethics approvals and any relevant Indigenous Cultural and Intellectual Property (ICIP) arrangements. The co-design process has identified, and will continue to identify, detailed knowledge products to be delivered in 2022, and in subsequent years and detailed data and information management plans will be developed for each of these. The data products developed through RP2023 will be co-designed with the Data Wrangler and Knowledge Broker to meet the FAIR and CARE guiding principles.

Project output	Data management and accessibility
<p>Synthesis report/brief/outcomes reviewing the current state of knowledge on the multiple benefits arising from the project</p>	<p>According to the Hub's data management strategy, information will be made publicly available on-website</p> <ul style="list-style-type: none"> It is expected that these will be derived from publicly available information, and there should be limited sensitives
<p>Reports and other written documentation including:</p> <ul style="list-style-type: none"> Preliminary report of findings to predict microplastic risk for EPBC Act-listed threatened species Progress report on a nationally consistent monitoring system (protocol) and national database for microplastic pollution A final report on microplastic fundamentals A preliminary report on tyre dust and recommendations for interception pilots Fact sheets and other communication tools about fit for purpose technologies for different waste demographic settings Yearly progress report for the Department and other research users summarising progress and results of the multi-year project. For 2023, this will include findings relating to Criteria (metrics) to evaluate technologies, a synthesis of existing waste demographic frameworks and metrics, evaluation of technologies, user requirements for a one-stop-shop for local governments and co-design outcomes Demonstration of case study 1 – Progress Report 	<p>According to the Hub's data management strategy, information will be made publicly available on-website.</p> <ul style="list-style-type: none"> The report / document will be identified by a unique code for identification. Dates and other metadata should follow ISO standards. Key words should also be included in the title and included as 'tags' to improve findability. Metadata should also clearly define the type of document, such as whether it is a report, a fact sheet etc. The metadata my include a preview picture to improve findability if appropriate Each type of document (report, fact sheet, etc) will follow relevant standards in terms of structure, identification, and format. This will streamline how the documents are presented and increase interoperability. The reports should include publicly available information to prevent sensitive information from spreading and to maximise accessibility. A data usage license should be included on the website and referenced at the beginning of the document to clarify reusability. Where data cannot be accessed without authorisation, a clearly defined procedure will be outlined to provide a methodology for requesting authorisation and providing the data securely. Specific safeguards will be implemented to protect privacy and data security. A data usage license should be included on the website and referenced at the beginning of the document to clarify reusability. A separate spreadsheet will be included providing raw data in a organised and clearly defined format, following a selected standard in terms of data organisation and identification. All documents will be communicated under the relevant sections on the website in consultation with the knowledge broker and communications manager. A title page should be appended to the beginning of each document, providing detailed metadata including globally unique and persistent identifier, related data spreadsheet with its own unique and persistent identifier, data usage license

Project output	Data management and accessibility
	<p>reference, domain-relevant community standards and detailed provenance.</p> <ul style="list-style-type: none"> Indigenous data gathered for regional and remote communities will be co-designed with the Indigenous facilitator to ensure compliance with CARE principles and ICIP. It is expected that RP2024 and beyond will have far more emphasis on Indigenous engagement.
Annual Technology forecast for evaluated technologies	<p>Like the approach to data management and accessibility for documentation including reports and fact sheets, the Annual Technology forecast should contain appropriately structured metadata for identification, reusability and referencing.</p> <p>Whilst data may not be required to be included via a separate, uniquely identified spreadsheet, appropriate referencing must be included following the same standards as selected for all documentation on the website.</p>

Location of research

The table below describes the scale at which the project will be working, and the location/s where the majority of the project research will be conducted.

The majority of work will be undertaken remotely using online facilities to conduct co-design workshops and meetings and desktop-based activities, either at UNSW, Sydney or Curtin University. Where safe to travel and COVID-19 measures are in place, face to face meetings will occur with Indigenous communities and other communities and stakeholders in regional and remote locations. Locations are yet to be determined for the 3 demonstration case studies.

Any prototyping and laboratory work relating to materials analysis will be undertaken at the UNSW Sydney Kensington Campus. Any remanufacturing sample products will occur at the Cootamundra MICROfactorie, Shoalhaven MICROfactorie and a separate Nowra MICROfactorie.

IP2.02.01 - Understanding Microplastics			
At which spatial scale is the project working	National	Regional	Local
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Location(s) – gazetted region /place name	Desktop Studies: UNSW Sydney, Kensington Lab Work: UNSW Sydney, Kensington Field Studies: Currently being codesigned with stakeholders under IP2 The research outputs from IP2.02.01 will be tested at a local and regional scale through pilot interceptions, however the outcomes will have national significance.		
Aboriginal or Torres Strait Islander nation or traditional place name(s)	Desktop Studies: Eora Nation Lab Work: Eora Nation Field Studies: Currently being codesigned with stakeholders under IP2 The research outputs from IP2.02.01 will be tested at a local and regional scale through pilot interceptions, however the outcomes will have national significance.		

IP2.02.02 – Finding fit for purpose technological recycling solutions for regional and remote communities across Australia			
At which spatial scale is the project working	National	Regional	Local
	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Location(s) – gazetted region /place name	Desktop Studies: UNSW Sydney; Curtin University Field Studies: Currently being co-designed with stakeholders under IP2. Potential sites include Bunbury, WA, Huon Valley, TAS, and Murraylands and Riverlands, SA. The research outputs from IP2.02.02 will be tested at a local and regional scale through pilot demonstrations, however the outcomes will have national significance.		

<p>Aboriginal or Torres Strait Islander nation or traditional place name(s)</p>	<p>Desktop Studies: Eora Nation; Wajuk Country</p> <p>Field Studies: Currently being codesigned with stakeholders under IP2. Potential locations include Wadandi Country , Nuenonne Country and Ngarrindjeri and Erawirung (Yirawirung, Jirawirung) Country .</p> <p>The research outputs from IP2.02.02 will be tested at a local and regional scale through pilot demonstrations, however the outcomes will have national significance.</p>
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Project keywords

Microplastics, tyre dust, circular economy, waste, regional/remote, re-manufacturing, Microfactories