engineers without borders australia

RS Group

2024 EWB Challenge Design Brief

Saibai Island

Torres Strait

Introduction

The 2024 EWB Challenge is delivered in collaboration with the Torres Strait Island Regional Council (TSIRC) with a focus on Saibai Island in the north west of the Torres Strait region. Projects and supporting resources were developed by EWB Australia with generous assistance from the TSIRC team. Student design ideas will support EWB's Engineering team and put forward ideas to help TSIRC staff to deliver impactful programs on Saibai Island.

As you learn more about EWB and TSIRC, you'll recognise the importance of a place-based design approach and working alongside community members through the development of a project. While students and academics do not engage face-to-face with community members while working through EWB Challenge projects, a community-centred, place-based approach is manifested in the EWB Challenge process through the following steps:

1. Design Brief developed by the EWB Challenge team through meaningful community participation and based on decades of TSIRC's own community engagement. The Brief ensures students' design ideas are founded on addressing community-identified priorities.
2. Students use the resources provided (along with academic literature, publicly available reports, case studies and other reference material) to take a human-centred approach to research, innovation, and the generation of new insights in response to a design area listed in the EWB Challenge Design Brief.
3. The ideas, research, and resources developed through the EWB Challenge are shared back via EWB and TSIRC and investigated for further development and future implementation.

How was this brief developed?

The development of this brief was a comprehensive participatory process that prioritised community engagement and staff collaboration. The foundation for the design areas herein were laid through consultations with Saibai residents, who generously shared their insights and perspectives during EWB's visit to Saibai Island in mid-December 2023. Workshops with TSIRC staff in Cairns also fostered a deeper understanding of the context as the team delved into opportunities and challenges for design areas.

Advice on getting started

As you develop your design concept, you are encouraged to dive deep into Saibai Island and the surrounding Torres Strait Islands. Utilise all the resources available on the EWB Challenge website to immerse yourself in the local environment and culture, including the interactive resources, and start to uncover the opportunities and challenges that will influence your proposal. By taking the time to understand your project context, you will develop an idea that is not only technically feasible but appropriate and exciting for your stakeholders!

The EWB Challenge is an open-ended learning experience, and thus the breadth and depth of design is left to individual universities and design teams to scope within the context of the submission requirements. Design ideas that consider links between the individual project areas listed in the design brief are welcome.

All reports submitted to the EWB Challenge team will be shared with TSIRC to support their work on the ground in Saibai Island and other Torres Strait Islands.

Under no circumstances are students to contact community members, TSIRC staff, or their partners unless expressly permitted to do so by EWB. This is part of our agreement with community that enables everyone to participate in a manner that is respectful of time, culture, and resources.

EWB Australia acknowledges the Traditional Custodians of Country throughout Australia and their continuing connection to land, waters, culture and community. We pay our respects to Elders both past & present; and to emerging leaders. We recognise that Aboriginal & Torres Strait Islander peoples never ceded sovereignty.

EWB Australia likewise acknowledges Traditional Owners as the custodians of the Indigenous significance and meaning of the 'Engineering on Country' artwork that appears in this publication.

Title: EWB Engineering On Country Artwork

Artist: Tyrown Waigana 2021

Date: March 2021

Contents

Navigation

The key below links the design areas outlined in this brief with engineering and IT disciplines that are likely contributors to those areas. This is a guide only, however, and any discipline may have valuable contributions to offer across all design areas.

- Civil
- Computer / ICT
- Environmental
- Electrical
- Mechanical / mechatronics
- Industrial
- Chemical

EWB & Engineering on Country

EWB Australia works to improve the quality of life of people living and working in communities across the Asia-Pacific region. Relationships are central to our engineering work, and on that basis, EWB's Strategy 2030 is focused on supporting our community partners in Timor-Leste, Vanuatu, Cambodia and First Nations communities in Australia.

For EWB's work to effectively address challenges that communities themselves identify, it is important not to limit our work to any one discipline of engineering. That said, we find that much of our work tends to fall under the broad areas of water, sanitation and hygiene (WASH), agriculture, climate change, gender equality, disability and social inclusion, and to promote people's ability to live and thrive on their traditional lands. In all of these areas, the objective is that people's lives are improved through equitable and sustainable technology.

Our in-country teams are key to the success of our work, comprising technical specialists, project managers and technology development coordinators with diverse engineering backgrounds and extensive community engagement experience.

Engineering on Country

EWB Australia recognises and acknowledges Aboriginal and Torres Strait Islander People as the first engineers and scientists of this nation, caring for Country sustainably for over 65,000 years.

Our Engineering on Country (EoC) program supports Aboriginal and Torres Strait Islander People to pursue their aspirations to live and thrive on Country.

Since 2009, EWB has worked with Aboriginal and Torres Strait Islander communities across Australia on a range of community-identified projects. These have mostly taken place through long-term partnerships developed directly with communities and through pro bono support from our corporate partners.

EWB works with communities to design and provide access to appropriate and sustainable community infrastructure, which can include water & sanitation facilities, energy systems, housing, and other technology and services that improve people's quality of life and ability to pursue education, employment or income generating opportunities. We also work with communities to help design solutions that enable cultural connection.

Our Pathways Outreach program engages volunteers who are trained to deliver Introduction to engineering modules in primary schools, high schools and community centres in cities and in regional areas across Australia, through our chapter network and our industry partners. These programs aim to inspire youth to pursue a career in engineering and STEM, with a particular focus on engaging and increasing the participation of First Nations young people and others who are less represented in the engineering sector, such as women and girls.

Introduction to local government in the Torres Strait

This year's EWB Challenge design areas explore appropriate technology to support the community of Saibai Island in the Torres Strait to live and thrive on Country.

The Challenge community partner organisation is the Torres Strait Island Regional Council (TSIRC). As an elected local government body, TSIRC plays a pivotal role in fostering community growth and development. As you engage in projects where TSIRC is a key stakeholder, some understanding of the organisation and how it operates will help align your design efforts with opportunities to support the aspirations and needs of this unique and beautiful community on Country.

To understand TSIRC and its role in the community, including both what it can do and the limitations of its authority, it is also useful to understand the broader governance structures it is a part of. There are several, closely related local government bodies active in and around the Torres Strait, including the Northern Peninsula Area Regional Council (NPARC), the Torres Shire Council (TSC), and TSIRC itself. State and Federal powers are divided between the Queensland and Commonwealth governments respectively, under the Australian Constitution. Each have different roles in the community. As with other local government bodies in Queensland, TSIRC's roles, functions, and responsibilities are established under the Local Government Act 2009.

Torres Strait Island Regional Council

Role: The Torres Strait Island Regional Council is a local government authority responsible for providing local government services to the Torres Strait Islands.

Functions: The council's functions include delivering essential services such as waste management, local infrastructure, environmental management, and community development within its jurisdiction.

TSIRC plays a crucial role in the governance and administration of the region. Comprising 15 elected Councillors representing 15 island communities, TSIRC is responsible for delivering a wide range of services and programs to the local communities, including infrastructure development, waste management, environmental conservation, and cultural preservation initiatives.

TSIRC actively collaborates with various stakeholders, including government agencies, traditional landholders, and community organisations, to ensure that the unique cultural and environmental heritage of the Torres Strait Islands is safeguarded for future generations. Through its strategic planning and community engagement efforts, the council works toward maintaining the delicate balance between sustainable development and the preservation of traditional practices and natural resources.

Moreover, TSIRC is committed to upholding the rights and interests of the Torres Strait Islanders, including their traditional knowledge and customary practices.

This commitment is evident in the council's efforts to protect marine ecosystems, such as the implementation of sustainable fishing practices and the conservation of critical habitats for

endangered species like the dugong, which are valued by the Islanders for both their cultural and economic significance.

TSIRC envisions a future where the Torres Islands thrive as resilient and sustainable communities, preserving and celebrating their cultural heritage while embracing progressive opportunities for growth Strait

Torres Shire Council

Role: Torres Shire Council (TSC) is one of the local government areas within the Torres Strait region.

Functions: Torres Shire Council is responsible for local governance, infrastructure development, and the provision of services to the community within its specific area.

Northern Peninsula Area Regional Council

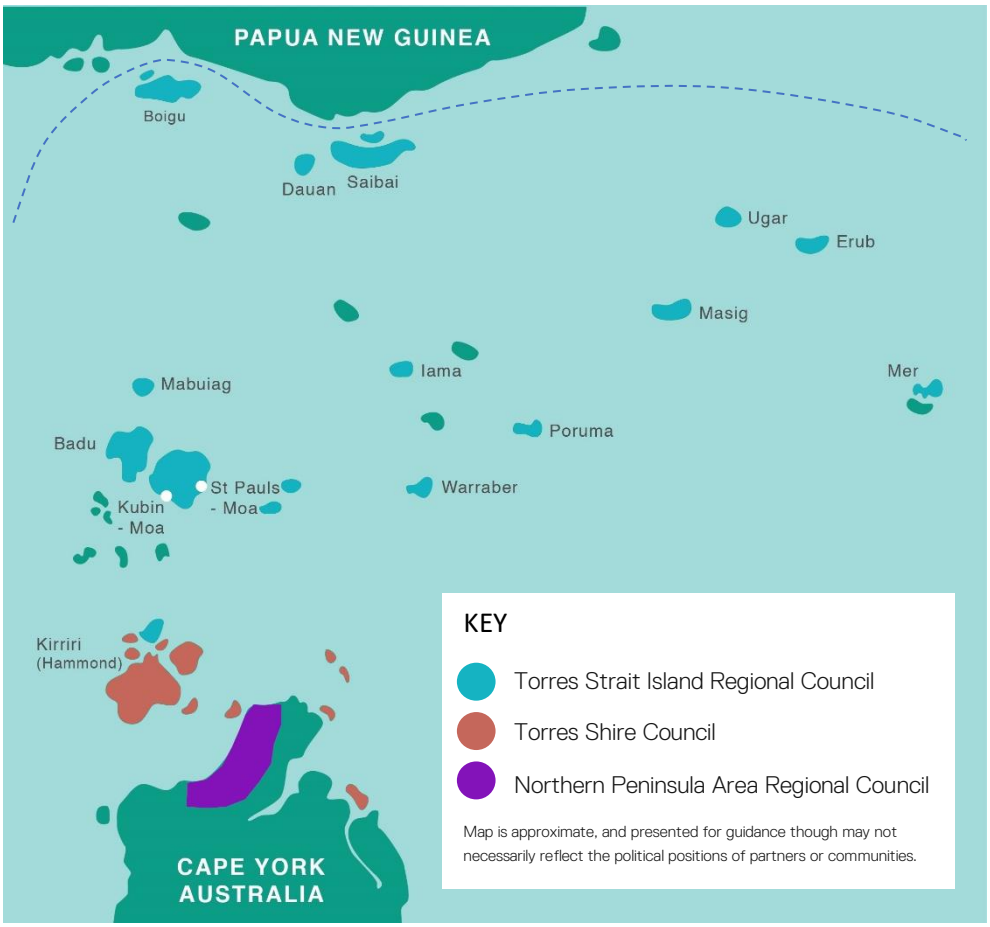
Role: The Northern Peninsula Area Regional Council (NPARC) is a local government authority covering the Northern Peninsula Area of Queensland, which is part of the broader Torres Strait region.

Functions: Similar to the TSIRC, the NPARC is responsible for local governance and the provision of essential services to the communities within its jurisdiction.

Complementary governance

Role: In addition to the local government Councils established under Queensland state legislation, the Torres Strait Regional Authority (TSRA) is a Commonwealth statutory authority that operates at a regional level. It was established to represent the interests of Torres Strait Islanders and promote their economic, social, and cultural development, and its role is complementary to that of local government.

Functions: The TSRA is involved in a range of activities, including community development, cultural preservation, natural resource management, and economic development.



Local government areas in the Torres Strait (adapted from TSIRC (2024) 'Map of Torres Strait'

Saibai Island

Introduction

Geography

Saibai is located among a cluster of islands in the north-west Torres Strait, approximately 150 kilometres north of the Australian mainland and approximately 4 kilometres south of the International Maritime border with Papua New Guinea.

Saibai is low-lying alluvial mud island, covering an area of around 108 km^2. The island is largely characterised by a flat topography with a mix of sandy beaches, lush vegetation, and a significant area of central mangrove wetlands.

The township has been established on a narrow strip of beachfront, and with its highest point only 1.7m above sea level, the community is inundated several times a year by king tides. As we will see in design area five, a concrete seawall built in 2017 to augment an earlier 1900s wave return wall still faces significant challenges.

The 2021 Australian census recorded a total population of 338 people living on Saibai, with 90% of respondents identifying as Aboriginal and/or Torres Strait Islander. Anecdotally, residents suggested the population was closer to 500, which is consistent with the population measured in the 2016 census.

Climate

Saibai demonstrates a tropical climate, with distinct wet season (October-April) accounting for approximately 95% of annual rainfall. El Niño typically brings below average rainfall, while La Nina years display the opposite. Heavy rainfall and strong winds are often seen at the onset of the wet season. While Saibai is not highly prone to tropical cyclones, it does experience the indirect impact of such event off the eastern Australian coast in the form of storm surges.[1]

Culture

The Saibai Islanders have preserved their traditional practices and customs, passing them down through generations. These include intricate dances, ceremonies, and rituals that are an integral part of the islanders' way of life. Traditional dances often depict stories of the sea, nature, and historical events, providing a vibrant expression of Saibai's cultural identity.

Saibai Islanders maintain a deep connection to their natural surroundings. Fishing and agriculture play crucial roles in their daily lives, and the island's residents have developed sustainable practices that align with their cultural values. Traditional fishing methods and sustainable agriculture contribute to the islanders' self-sufficiency and are integral to their cultural heritage.

[1] Suppiah, Bathols, Collier, Kent & O'Grady (2010) Observed and future climates of the Torres Strait Region, CSIRO

Language

Kalaw Kawaw Ya (KKY), is a language spoken in the Torres Strait region, predominantly in Dauan, Saibai, and Boigu Islands. It encompasses a rich tradition of storytelling, oral history, and cultural expressions that are deeply rooted in the Land and Sea Country of the region. In interviews with the EWB team, community members discussed the importance of language preservation for cultural heritage, identity, solidarity, and wellbeing. Efforts to teach KKY in local schools are among the approaches taken to keep the language alive.

'Yumplatok', or Torres Strait Pidgin, is also spoken across the region extending from northern Cape York to the south-west coast of PNG.

It is important to remember that the words we use to talk about our work have deeply embedded ways of thinking. As Tyson Yunkaporta points out, discussing Indigenous concepts in English 'inevitably places settler worldviews at the centre of every concept, obscuring true understanding'.[2]

Paying attention to the assumptions and power dynamics embedded in our language and design processes can help to improve the effectiveness of our work.

Australia-PNG treaty

The geographical proximity between Saibai Island and Papua New Guinea (PNG) has contributed to the interconnectedness of the communities, particularly in terms of trade, cultural exchanges, and familial relationships. While Saibai is politically a part of Australia, its proximity to PNG has fostered cultural and social connections between people of both communities. In addition to historical and ancestral ties between Saibai Islanders and the people of PNG, environmental and climate-related challenges such as rising sea levels and changing weather patterns are issues that impact both communities.

The Torres Strait Island Treaty offers insight into the political cooperation and mutual support between Australia and Papua New Guinea. Signed in 1978, the Torres Strait Island Treaty delineates the maritime boundaries and sovereignty between Australia and Papua New Guinea in the Torres Strait region. The treaty acknowledges the traditional rights of Torres Strait Islanders to freely navigate and access resources across maritime borders, in recognition of the cross-border connections. The treaty also established the Torres Strait Protected Zone, a designated area where traditional activities, including fishing and cultural exchanges, can be carried out by the Torres Strait Islanders and the people of PNG.

Land tenure and Native Title

Native title refers to the legal recognition of Indigenous Australians' rights and interests in their traditional lands, as affirmed by the landmark Mabo decision in 1992 and set out in the Commonwealth Native Title Act (1993). As per the consent determination on 12 February 1999 in Saibai People v Queensland (1999) FCA 158, Native title rights over much (though not all) of the island are held by the Saibai People. Native title in Saibai is managed by the Saibai Mura Buway (Torres Strait Islanders) Corporation.[3,4]

ILUAs can cover a broad range of matters, including land access, compensation, cultural heritage protection, and economic development opportunities. The negotiation and

[2] Yunkaporta (2019) 'Sand Talk', Text Publishing
[3] Federal Court of Australia (1999) Saibai People v State of Queensland
[4] National Native Title Tribunal (1998) QCD1999/001 - Saibai Island

implementation of ILUAs involve a collaborative process between Indigenous parties and the entities seeking to use the land. These agreements reflect a commitment to balancing the recognition of native title rights with the broader interests of development and resource use.

There are three types of ILUAs:

- **Area agreements:** When there is no registered native title body corporate (RNTBC) for the entire agreement area
- **Body Corporate Agreements:** Where there is one or more RNTBCs for the entire agreement area, other than for any part of the area where it has been determined that native title does not exist
- **Alternative procedure agreements:** where there is at least one representative body for the area or at least one RNTBC in the area, but not where there are RNTBCs in relation to all of the area.[5]

At the time of writing, the National Native Title Tribunal records lists seven ILUAs in place on Saibai.

Indigenous Land Use Agreements (ILUA)

ILUAs are key legal instruments in Australia that formalise agreements between Indigenous communities, governments and other stakeholders regarding the use and management of traditional lands. These voluntary agreements are enacted under the Native Title Act 1993 and provide a framework for recognising and accommodating Aboriginal and Torres Strait Islander interests in land and waters.

Additional information

- TSIRC (2024) 'Saibai'
- TSIRC (n.d.) 'Planning Scheme'
- TSRA, TS, TSIRC, NPARC, Queensland Government (2012) 'Saibai Community Booklet'
- Queensland Government (2024) 'Saibai'
- Australian Bureau of Statistics (2021) 'Census

Saibai Island at sunset

[5] National Native Title Tribunal (2024) About Indigenous Land Use Agreements (ILUAs)

Design considerations

Listed below are some considerations that we recommend you factor into your EWB Challenge design idea to ensure it is appropriate to the context. You might ask yourself these questions a few times throughout the design process – it's okay if you don't have all the answers in week one!

You are encouraged to include a response to each of the below considerations in the design proposal submitted for the EWB Challenge.

You'll also find 'context-specific' design considerations that provide more detail on what a particular community partner and community representatives consider most important when designing and delivering projects with them.

Check out our FAQ guide if you have questions that you can't find the answers to: Some Big Tricky Questions: Explained.

General Considerations

Sustainability – Consider the long-term sustainability of your project proposal. What measures could be put in place to ensure the successful continuation into the future?

Impacts on community – What impact will your design have on members of the community? Who are your key stakeholders? Is there anyone you haven't included?

Community engagement – How would you propose EWB could potentially engage and consult the community throughout the project? Think about the initial design right through to implementation. What avenues are there for community members to become involved? What form(s) of community engagement might be required for your particular design response?

Cost and economic benefits – What is the estimated cost of the project? Think about the 'Capital Expenditure' (initial cost to start) and Operational Expenditure (ongoing costs over time), which might include material costs, implementation, operation/program delivery costs, and maintenance costs. Take into consideration local currency and costs. Also, consider if there are any potential economic benefits to the community which could result from the project.

Effective technical design – Is the technical design the most appropriate and effective for this context? Take the time to show what alternatives were considered and why you are proposing your design as the most appropriate. Previous EWB Challenges show that often the most successful designs are often ones that are simple and can be implemented / prototyped (tested) rapidly.

Impacts on environment - What impact, both positive and negative, will your design have on the local environment? What measures can you put in place to mitigate any negative impacts?

Materials and Access – Have you considered the use of locally available materials that are culturally acceptable and environmentally friendly wherever possible? Transportation of project materials and availability of materials which might be required for future maintenance are a significant consideration for projects in remote locations. Where might your proposed materials be sourced from? Also factor the challenges involved in freight and transport, and resulting implications for importing materials and human access.

Delivery and ongoing management – Who might construct and/or implement the project? Is the design response one that considers local capacity for ongoing management, repair, and maintenance? As much as possible, does your design or system proposal align with locally available expertise?

Inclusion of all – Is your proposed engagement approach, final product, and user experience inclusive of and accessible to all people? It's helpful to challenge yourself to think beyond a 'typical' user and consider a variety of diverse individuals who will have differing abilities and needs (and might be time-bound, for example, while pregnant or while recovering from an injury). Designing for inclusivity not only opens tools, products, and services to more people, it also authentically reflects who people are and tends to create an improved experience for everyone.

Context-specific considerations for Saibai Island:

Interconnectivity – Often, one component of community infrastructure or services will depend on others in order to function effectively. Because of this, some solutions cannot be addressed in isolation. A design to address one challenge that does not consider how it is linked to other parts of an interconnected system can risk simply shifting the burden to another place, community, or time. For example, the quality of health services is dependent on potable water and a reliable power supply; groundwater can be contaminated by improperly maintained landfill sites; and road surfaces can be damaged or eroded by stormwater runoff.

There is a clear benefit to dealing with the interdependences in a coordinated rather than an isolated or ad hoc manner. It is not expected that one person or team has the answers to every challenge, but in considering your design areas it can be helpful to at least recognise and flag the ways your proposal could impact others. This highlights to the benefit of collaboration across a diverse range of skillsets, perspectives, and understandings.

Lifecycle – Effective engineering solutions to a problem should aim to minimise environmental impacts throughout the entire lifecycle of a product. What happens to a product after it reaches the end of its utility is a crucial consideration for the resilience and sustainability of ecosystems and communities. By integrating end-of-life considerations into designs, students can contribute to the development of a circular economy which promote the reuse, recycling, and repurposing of materials.

Students can explore the concept of designing for durability and longevity, which can prolong the useful life of a product and reduce the frequency of disposal. Additionally, incorporating remanufacturing and refurbishment processes into the design can extend the lifespan of products, minimising the generation of waste.

Seasonality and climate change – Designs should be resilient to changes in environmental conditions pertaining to the region. Things to consider include varying rainfall across the wet and dry seasons, water supply, changing landscapes, and/or increasingly hot land temperatures in summer, amongst others.

Design area one

Waste management

Background

Saibai Island, like many other islands in the Torres Strait, faces challenges with managing solid waste. With limited space, challenging environmental conditions, and strict biosecurity regulations, solid waste management presents significant environmental challenges. The solid wastes on the island typically arise and can be defined from three streams:

- domestic and municipal—includes all household waste and waste collected in public places;
- commercial and industrial waste from all business and industrial activities and public institutions; and
- construction and demolition—includes all waste from the building and construction activities.

As well as the more obvious obstacles, like available space for landfilling or energy for intensive waste treatment processes, a series of interconnected 'micro-problems' can also arise, when a solution to one problem creates difficulties for another. For example, the logistics required to remove waste from the island and transport it to recycling/disposal facilities on the mainland can be extremely costly in their current form. Additionally, biosecurity regulations require bins to be tightly lidded for removal off the island to prevent water ingress and the potential for vector born mosquito larvae. However, this in turn means that the bins cannot be stacked for shipping. While burning waste can be an accessible option for waste reduction, this can have significant implications for the delicate surrounding ecosystems. Across multiple points in the process of collection, treatment and/or disposal of waste, typical approaches seen on mainland Australia are inappropriate for the Saibai context.

Indeed, waste management is a problem faced by many island communities (see additional resources). Vehicles, oils, tyres, electronics, whitegoods, medical waste, and even asbestos are among the more challenging materials to deal with after they have reached end-of-life. A prominent example is inexpensive white goods imported from the mainland, which are often cheaper to replace than to repair, yet are difficult to dispose of at the end of their lifespan. So too disused vehicles once no longer usable can occupy landfill space that could be used for other purposes.

A further challenge is solid waste that accumulates along coastlines, including material carried by currents from other islands or even countries. Discarded ghost fishing nets, for example, wash ashore in considerable quantities. In such instances, the Saibai community has little control over the disposal practices of others, yet still faces the challenge of managing these waste products.

Current facilities and processes

Saibai currently has a landfill facility located at the eastern end of the island, near the Telstra telecommunications tower (see interactives for greater context). Domestic waste is collected twice per week with a rubbish truck, free of charge for residential properties and with an annual levy applied for commercial properties.

There is no recycling option currently available on the island.

With little available soil for backfill and with significant areas of land exposed to water inundation, burning waste is not always a safe or practical option. Materials are burnt at the landfill site due to limited space availability, though burning is not as common on Saibai as some other islands in the Torres Strait and is not without environmental implications. Other types of waste, however, are not suitable to be burned. In either case, the long-term impact of the waste management system has yet to be determined.

Saibai landfill facility

Biosecurity

Biosecurity is a critical component of environmental management in the Torres Strait. Located between Australia and Papua New Guinea, the Torres Strait Islands host a delicate ecosystem with distinct biodiversity challenges. Saibai is located in the 'Torres Strait Permanent Biosecurity Monitoring Zone' , which carries specific restrictions on moving goods out of the region.

Biosecurity in the Torres Strait Islands is regulated with both State and Federal legislation, to prevent the spread of contaminants or invasive species that may be present in or attached to different materials. Key legislation includes the Queensland Biosecurity Act 2014 and Biosecurity Regulation 2016; and the Commonwealth Biosecurity Act 2015.

Measures by TSIRC to manage community waste are thus required to meet these regulations. Biosecurity regulations apply not only to organic waste products, but also to things that can carry pests, including packaging, appliances, machinery, and vehicles. The regulations on necessary steps to deal with these risks are detailed in the Queensland Biosecurity Manual, and include approaches such physical removal, and chemical treatment, and steam cleaning. As you can imagine, such biosecurity measures can be quite

resource intensive and challenging to implement in a place like Saibai.

When treatment cannot be carried out on the island itself, an alternative option is to transport it to an approved 'waste management facility' in accordance with the legislation. However, it is important to note that the nearest such facility is located in Cairns, some 885km away. Moreover, as the waste would move across the boundaries of the Permanent Biosecurity Monitoring Zone, transport arrangements must meet the strict legislated containment requirements for restricted matter.

Small scale recycling has been trialled on other islands, and may have a role to play in waste management on Saibai. However, it is important to note that for recycling to be effective, there must also be a use or purpose for the product or by-product of the recycling process.

Design opportunities

1.1 Working with biosecurity

What technologies, processes, or techniques might help the community and Council to satisfy their biosecurity obligations? How could waste be treated locally or be transported off Saibai in a way that satisfies biosecurity measures? This design area explores local treatment options aligned with biosecurity measures to ensure safe waste reduction and treatment on the island.

→ Biosecurity and logistics (see opportunity 1.2) are closely related. You might like to consider them together!

1.2 Logistics

The current need for tightly lidded bins that meet biosecurity compliance obligations conflicts with efficient stacking during shipping, contributing to high operational costs. Developing innovative containerisation methods that align with biosecurity measures and exploring alternative methods of transportation present significant opportunities for improved waste management on Saibai.

Likewise, an integrated waste management hub on Saibai that incorporates sorting and preliminary treatment facilities could improve logistics by sending only processed or compacted waste to mainland facilities.

With multiple stakeholders involved, collaboration is a crucial for developing effective waste logistics solutions that comply with regulations while minimising environmental impact.

1.3 Minimising plastic waste

Plastics are a growing waste stream with currently limited management processes. In this project, teams will investigate appropriate ways to reduce the amount or types of plastic waste produced in island communities, and propose mechanisms through which the negative impact of this waste stream might be reduced or mitigated.

Above: Strict customs measures impact movement from Saibai

Below: Managing waste is a significant challenge

1.4 Waste as a resource

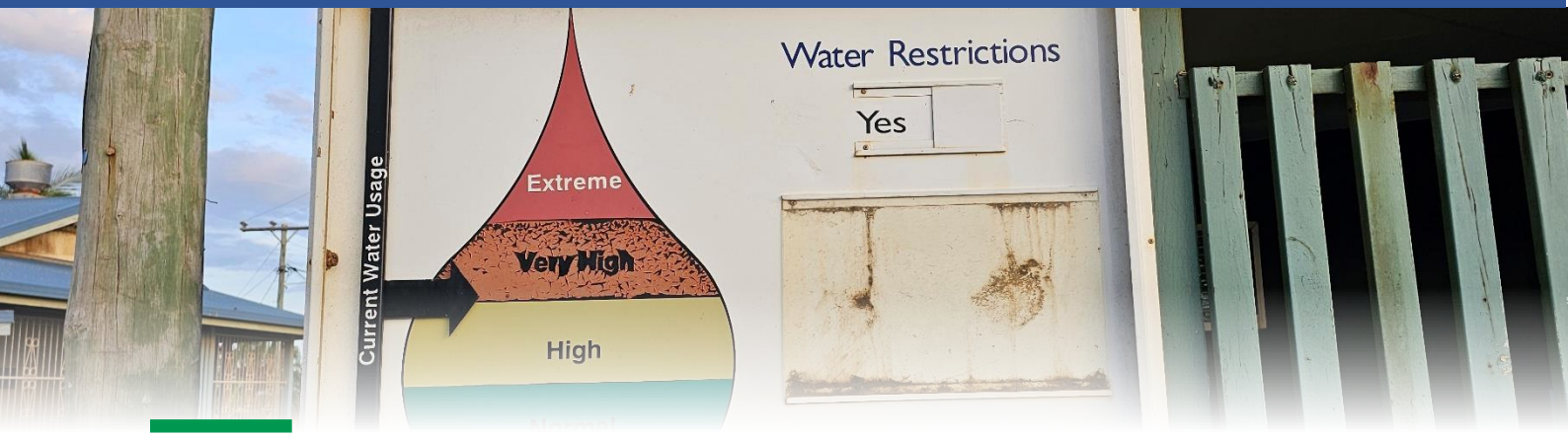
The challenges of centralised waste collection and disposal in a remote area open up opportunities to more deeply explore recycling or upcycling the most common forms of waste found on Country. This project explores appropriate repurposing of common waste items, including ghost nets and plastics which commonly wash up on Saibai's shorelines.

Small scale recycling has been actioned elsewhere around the globe, and is not itself a new concept. However, it is not just the ability to recycle that presents a challenge: there is also the question of what to do with the outputs or by-products of a recycling process. Innovation in this area may be overcoming practical barriers

⚠ Be careful not to place all the responsibility on individuals or even local communities to reduce their own waste. People may well want to reduce their waste, but might not have the opportunity to do so due to factors outside their control, like access to alternative products or systems.

Additional information

- Angeloni, A. (2023) 'The Cocos (Keeling) Islands is in a rubbish dilemma, but could there be lessons for the rest of the world?' ABC News
- TSIRC, TS, NPARC, TSRA (2018) 'Torres Strait Regional Biosecurity Plan 2018-2023'
- DAFF (2024) 'Biosecurity', Australian Government
- DAFF (2024) 'Moving goods to, from and within Torres Strait'
- LGAQ, Queensland Government (2021) 'Respecting Country: A sustainable waste strategy for First Nation communities'
- TSIRC (2024) 'Priority Area Two - Local waste management strategy'
- TSIRC (2024) 'Waste Facilities & Charges'



Design area two

Water and sanitation

Water quality and quantity

Saibai Island faces complex challenges in managing its water resources. When rain falls on the inland catchment area, runoff is directed towards the central wetlands. In heavy rainfall events, the catchment spills its outflow to the ocean. However, some of this rainfall is captured in large surface area lagoons, treated and distributed to the urban areas as a potable water source.

Yet, access to water is not only for basic needs like drinking, cooking and washing. Water is also crucial for a safe and dignified standard of living, which includes water for production, livelihoods, culture, and psychological wellbeing. For many people, water is not only a material resource; it is a deeply interwoven part of a spiritual understanding and being in the world. As such, water can also be closely connected to identity.

When we think about people's access to water, there are at least two key angles that should be considered: supply-side approaches, and demand-side approaches. Supply-side thinking focuses on the capture and delivery of water, where improvements are characterised by looking for ways to increase the amount of water supplied. Demand-side thinking, on the other hand, looks at the usage of water, including how people can alter their behaviour to reduce demand. On both sides of the coin, efficiency can play a significant role.

Water sources and treatment

Rainwater is the primary source of potable water on Saibai. Rainwater is collected from various sources including a large, lined central lagoon, secondary uncovered lagoon catchments, and household rainwater tanks. The central lined lagoon covers a 6.5 Ha catchment area. Lagoon water undergoes chlorine dosing for disinfection treatment, with treated water then distributed to the community through an underground 80mm mains pipe.

Beyond rainwater, small scale reverse osmosis units can supplement potable water supplies in times of acute need. However, as is typical of mechanical desalination, this reverse osmosis is very energy intensive for relatively small water yield. As such, producing water by this method is closely interconnected with energy availability and infrastructure.

Wastewater

Saibai is served by a reticulated sewer network, incorporating approximately 3.2km of piping. Inspection holes provide service access, though their cover plates generally sit at levels marginally below the highest astronomical tide (HAT) level, presenting risk of saltwater intrusion into the sewer system in the event that the seawalls are overtopped. The primarily gravity fed sewer network is supplemented by three pump stations, a lift station and associated rising (pressure) mains which deliver sewage to a wastewater treatment plant (WWTP). The WWTP is a 'package' (predesigned) configuration specifically intended for use in remote communities, with rotating bio contactors designed for low operation and maintenance inputs. Nonetheless, the plant requires electricity to run key components.

Design opportunities

2.1 Drinking water quality

Though water sourced from the central lagoon can be dosed with chlorine, multiple water sources in a drinking water system can introduce alternative opportunities for contamination. Some households in the community choose to boil water for an added redundancy of disinfection before drinking, but this is of course an energy intensive option and not particularly convenient.

There is opportunity to investigate alternative ways to improve the quality of drinking water sourced from natural sources including surface water, groundwater or rainwater to ensure it meets safe drinking water standards. Narrowing the scope of this opportunity, students can explore opportunities at either the household level or centralised community level, and/or combine it with other projects such as.

→ This project could be combined with others such as structural design, energy, or monitoring

2.2 Low resource desalination

Desalination is used on Saibai for emergency replenishment of drinking water supplies. Mechanical desalination is performed by forcing salty water through a membrane that contains holes smaller than salt particles, and thus removing the salt from the liquid. It is an effective process, but requires very high pressures to force the water through the membrane, which results in an intensive demand for energy. A design opportunity for a viable alternative to desalinate water may add value in this area.

→ This project is closely interconnected with energy and could be combined with designs from that perspective

2.3 Grey water management

When groups camp on Country, there is a certain amount of water runoff (from activities such as showering) that is released into the environment. There is interest in exploring viable alternatives to grey water trenches which incur considerable costs, particularly due to challenging ground conditions at numerous sites. This prompts the need for solutions which enable the appropriate management of grey water runoff and prevent or mitigate any potential negative environmental impacts.

→ This project could be combined with other water and sanitation projects, and beyond

Additional information

- Australian Drinking Water Guidelines
- United Nations Environment Programme (2019) 'Towards sustainable desalination'
- YourHome (2024) 'Wastewater reuse', Australian Government

Top left: Central lined lagoon

Top right: Secondary lagoons

Middle: Water treatment plant

Bottom right: Wastewater treatment plant

Bottom left: Sewer access hole adjacent to concrete seawall, with concrete-lined drainage swale

Design area three

Infrastructure

Marine transport

Transport and access on Saibai Island present unique challenges shaped by its geographical and environmental context. The primary mode of water transport is small individual recreational vessels, including long boats, dinghies, and banana boats. Notably, long boats are imported from Papua New Guinea, underscoring the island's reliance on neighbouring regions for essential transportation infrastructure. The absence of commercial ferry services between the neighbouring islands and communities exacerbates the reliance on individual boats, particularly dinghies, for everyday transportation needs. While considered the most affordable option for inter-island travel, dinghies can nonetheless be dangerous in rough seas or strong currents in the area.

The marine facilities at Saibai consist of a precast concrete boat ramp, a timber pier, a rock wave return wall and a concrete seawall. The boat ramp and pier facilities are accessed from the deep water by a dredged channel, which is marked by navigational buoys.[6] The boat ramp and pier provide access for all goods transported to the island by sea, and thus form an essential part of the community's infrastructure.

TSIRC has rated the risk associated with its community marine infrastructure as 'severe', which indicates 'Less than 3 years useful life left, however are only kept open due to unsustainable maintenance works which do not address the primary structural elements (piles, bearers, etc).'[7]

According to TSIRC, 'Age and wear and tear have rendered the majority of marine infrastructure facilities no longer suitable for most communities, and especially for people with a disability .... Without reliable marine infrastructure, travel and access is compromised ... having a negative impact on health, education, traditional hunting, basic groceries and services'.[8]

Air transport

Saibai Island does not have a safe passenger ferry service or other public transportation, with small fixed-wing aircraft and helicopters the only commercial means of entering and leaving the island. However, such modes of transport can be expensive, particularly for freight, creating significant economic challenges for the Saibai community.

The aircraft facilities at Saibai comprise a fully fenced airfield located at the northern end of the community with a sealed airstrip approximately 750 meters long and 60 meters wide. Other facilities include an aircraft hardstand area, and helipad. Although there is no associated terminal building, there is a covered waiting area adjacent to the tarmac. Operation and maintenance of the airfield facilities is the responsibility of the TSIRC.

[6] TSRA n.d. 'Saibai Sustainable Land Use Plan Part 2'
[7] TSIRC (2024) 'Priority Area One – Marine infrastructure and equitable access'
[8] Ibid.

Internal road transport

Road access has a significant impact on daily life for the Saibai community. Combined with mostly unsealed or gravel roads, such flooding can make roads dangerous or impassable, limiting movement and ready access to parts of the community. The school access road, for instance, is prone to flooding from very high tides and storm surges, and this can impact students' ability to attend class.

Building materials

The Holy Trinity Church building, completed in 1938, was largely constructed using local materials offering insight into the possibilities and limitations of some locally available products. The materials used in the construction of the church include burnt coral, mangrove and Wongai plum timber. Its foundations, floor and walls are made with unreinforced mass concrete with crushed coral aggregate, lime cement, and sand. The internally-exposed timber roof trusses support fibrous cement sheeting, with the structure incorporating materials and hand carved furnishings of an earlier church that stood on the same site. However, a structural assessment has deemed the Church unsafe for public use without a permit. At the time of writing, there were no stated plans to restore the building.

Design opportunities

3.1 Safe and dignified marine access

Considering the essentiality of marine access for the community, low maintenance solutions could be developed to enable safe and durable access to a range of watercraft, including barges, passenger ferries and dinghies. Students are encouraged to consider varying tides levels over time (including into the future), safety considerations, and accessibility for all.

3.2 Improved local road access in the wet season

Unsealed roads on the island can become muddy and dangerous to use in the wet season. This affects local movement for the community, including to the school which can discourage kids from attending. This project explores utilisation of low cost/ locally sourced materials to develop structures that improve access on muddy roads and are easy to maintain locally. Structures could be temporary or permanent in line with student's assumptions

3.3 Low resource building techniques and materials

Though much has changed in construction technology over the almost century since the Holy Trinity Church was constructed, some techniques remain in common use today. For instance, the use of coral aggregate for making concrete continues to be a common building technique across the Pacific region due to its availability, and improving the utility of these or other locally available resources may present positive implications for cost, maintenance, and carbon footprint.

→ **There may be infrastructure design opportunities in other sections, such as seawall improvements**

Additional information

- Queensland Government (2023) 'Building accessible places'
- AECOM (2011) 'Inundation Management on Saibai, Boigu and Iama Islands'
- TSIRC (2024) 'Priority Are One – Marine infrastructure and equitable access'
- Pacific Islands Forum Secretariat (2021) 'Pacific Resilience Standards : A Practitioner's Guide'
- Australia Pacific Climate Partnership (2023) 'Resilient Infrastructure Good Practice Guide'
- Zahra, T. (2021) 'Mix design and properties of coral aggregate for Oceania islands', QUT

Top left: local marine transport

Top right: Main community boat ramp in foreground, with main jetty in background.

Bottom left: Saibai aerodrome

Bottom right: Saibai Holy Trinity Church

Design area four

Energy

A central power station located in the southeast area of the Saibai community, with multiple diesel generator sets providing an independent power supply for the island. The generator sets are modular and interchangeable, which allows for maintenance and repair without the power station needing to be taken offline. The school, hospital, and water and wastewater treatment plants are among the highest consumers of electricity on the island.

The Queensland Government contracts Ergon Energy to provide power generation, distribution, and supply. Electricity is purchased from Ergon Energy with prepayments, which is required by legislation to be sold at the Queensland Notified Prices, as set by the Queensland Competition Authority (QCA). Credit options are also available to manage energy costs.

To supplement energy sourced from the power station, many residential and commercial buildings on Saibai are fitted with solar hot water systems. Additionally, bottled gas is a common energy source for various household needs, contributing to a diversified energy mix.

Despite efforts to maintain a stable energy supply, occasional power outages occur. The vulnerability of power poles to northwest winds poses a challenge, as the infrastructure is susceptible to damage. The bending of power poles under the influence of strong winds raises concerns about the long-term resilience of the power infrastructure, potentially leading to future issues if not addressed promptly.

Fuel is an important commodity on the island. As well as being used to power vehicles on land, petrol is heavily relied on for propelling dinghies - essential for inter-island travel. A single bowser dispenses both petrol and diesel at a fixed cost of $3.70/L, with the facilities owned and operated by TSIRC.

Design opportunities

4.1 Clean, affordable energy for small coastal urban environments

This opportunity tasks students to explore alternative energy sources that are reliable, affordable and accessible. Small-scale energy generation technologies could be studied and utilised while striving for lowering the cost of electricity relative to the main supply. Innovations in the area of energy storage may present opportunities for greater resilience of power supplies and its many interconnected flow-on effects, as well as addressing the challenge of battery design-life and its implications for waste management on Saibai. Alternatively, design ideas and research in this area might choose to focus on further enabling tried and tested renewables such as solar PV systems, or to explore other opportunities for improvements, such as the challenge of maintenance in remote communities.

4.2 Non-petroleum options for boating

Considering the Saibai community's heavy reliance on small watercraft for transport, this project area could investigate small, quiet, affordable, robust and agile alternatives to standard petrol-powered outboard motors for dinghies and other small boats. Design thinking in this area would need to consider the primary aim of facilitating transport alongside contextual considerations such as vibration and erosion control, disturbance to wildlife habitats, or embedded carbon footprint. Practical considerations might include durability, including withstanding bumps into mangroves, getting stuck in mud, and the need to be highly manoeuvrable.

4.3 Low cost, low energy refrigeration

While most of Saibai township is grid-connected, electricity supplies that are reliant on a single source of generation are exposed to higher risk of downtime should that power source fail. The remoteness of Saibai compounds the implications of this, in that loss of power has a profound impact on food, medicines and other perishables. This opportunity may centre on affordability and suitability for use in the community while reducing the impacts of inconsistent grid power. Design opportunities may centre on providing alternative or additional means of refrigeration for households or commercial purposes, utilising sustainable energy to power these appliances etc.

→ There may be opportunity here to support waste management, including lifecycle and/or bio-secure waste removal

Additional information

- CAT Projects, TSRA (2012) 'Torres Strait Options to Reduce Regional Carbon Footprint'
- 'First Nations Clean Energy Network'
- APCRC (2023) 'Resilient Infrastructure Good Practice Guide'

Above: Saibai power station

Left: Saibai fuel station

Design area five

Climate change adaptation

The Torres Strait Islands, including Saibai Island, face significant challenges due to climate change. The rising sea levels and changing weather patterns have a profound impact on the Torres Strait Islands. These changes not only threaten the physical landscape but also disrupt the traditional practices and livelihoods of the island's residents. The unique vulnerability of low-lying islands like Saibai exacerbates the risks associated with climate change, particularly in terms of water security, waste management and infrastructure.

TSIRC, along with relevant agencies and stakeholders, is actively engaged in studying and addressing the specific impacts of climate change on the region. By integrating traditional knowledge and innovative strategies, the council aims to facilitate adaption to the challenges posed by climate change while preserving the cultural heritage and ensuring the resilience of the community. This multi-faceted approach reflects a commitment to finding sustainable and culturally sensitive solutions to the complex challenges brought about by climate change in the Torres Strait Islands.

Saltwater intrusion

In the context of the Saibai community, the threat of tidal inundation, saltwater intrusion into groundwater, and coastal erosion present significant challenges. Such conditions have wide-ranging impacts on the daily lives of the island's residents, with transport and logistics, safe access to community facilities, and agriculture all affected by saltwater intrusion.

On the coastal side, Saibai's seawalls are built to provide protection from tides and storm surges. At the same time, the seawalls must allow for the outflows of water from the central wetlands. To achieve this, large culverts constructed to the east of the boat ramp and on either side of the airstrip connect the wetlands to the ocean, allowing water to pass beneath the road and seawalls.

Additionally, sea water inevitably overtops the walls from time to time, and rainfall over the township must also be able to drain away from built up areas. To achieve this, swales and surface drains within the township funnel water through pipes that pass beneath the seawalls, draining excess runoff to the ocean. These drain pipes are fitted with one-way flap valves, which when operating properly allow stormwater water to escape the system, but not to enter it from the ocean. However, failure of these valves exposes the system to backflow from the ocean into dry areas.

Community garden

In 2015, the Saibai Mura Buway Registered Native Title Body Corporate (RNTBC) in partnership with the Torres Strait Regional Authority (TSRA) initiated the development of the Saibai Mekem Garden community project. The project offers the Saibai community space and opportunity to use their traditional knowledge of subsistence gardening, fostered over thousands of years, to augment the more recent reliance on imports with affordable, healthy, locally sourced food.

The project has developed approximately 1Ha of small-scale farming land, situated 2km south-east of the Saibai township. The community garden is a

partnership between community members, TSIRC, the My Pathway economic development organisation, Rangers, and students from the local Tagai College. Seeing even greater potential in the facility, some community members expressed a view that there is opportunity to increase the garden's use and functionality.

Design opportunities

5.1 Seawall improvements

Typically, the flap vales fitted to stormwater drain pipes are designed with hinges or pins, which are exposed to very harsh wet-dry and high salt conditions. As such, corrosion or degradation of moving parts presents a significant maintenance and operations challenge, and failure of these parts exposes the drainage system to backflow. Could there be an opportunity to redesign this key element of the drainage system, either through adjustments to the valves, or by some other means?

5.2 Coastal erosion protection

Mangroves are an important feature for Saibai, serving a range of physical and cultural purposes, and communities are often involved in mangrove restoration activities. In addition, more and more is being understood about the important services that mangroves provide to ecosystems in terms of carbon storage and erosion control. However, when the purpose of the restoration relates to erosion control this has been historically challenging and it has proven difficult to protect the planted mangroves long enough to establish and resist the rapid currents that build up after heavy rainfall. As such, a method to ensure mangroves are protected long enough to become established and resist rapid currents could be highly valuable.

5.3 Sustainable Community Garden Expansion

Following progress made with the Saibai Mekem Garden community project, there is an opportunity to further expand and enhance the community garden, ensuring its long-term sustainability and contribution to local food security. This may require a focus on maximising land use efficiency, integrating eco-friendly practices like vertical farming and aquaponics, and further engaging the community for active participation. This initiative aims to not only bolster local food security but also reduce carbon emissions by promoting sustainable agricultural methods, lowering reliance on imported goods, and enhancing the resilience of the community in the face of climate challenges.

Additional information

- TSRA, TRS, TSIRC (2016) 'Torres Strait Regional Adaptation and Resilience Plan 2016-2021'
- AECOM, TSRA (2011) 'Inundation management on Saibai, Boigu and Iama islands'
- Parnell, Smithers, & Ischenko (2012) 'Understanding climate change driven coastal erosion an inundation impacts on Torres Strait communities and the development of adaptation options'
- Pacific Resilience Partnership (2016) 'Framework for Resilient Development in the Pacific'
- Pacific Islands Forum Secretariat (2021) 'Pacific Resilience Standards: A Practitioner's Guide'

Above: stormwater drain outlets fitted with flap valves.

Right: High and low tide comparison.

Below: Water spilling from central wetlands to the ocean through an under-road culvert.

Design area six

ICT

The information and communication technology (ICT) landscape on Saibai has allowed people to connect in new and different ways, access services, and interact remotely with others or the environment. This holds enormous possibilities for connecting people to Country and culture, maintaining that connection when mobility is a barrier, or to revive and record culture and histories.

Connectivity

For mobile connectivity, Telstra is the sole network provider and the island relies on a 4G network, with 5G not yet available. Smartphones are commonly used by the population. Eftpos services are accessible in key locations such as the supermarket and council office, facilitating electronic transactions. The use of satellite TV is prevalent in the community.

Early warning systems

Currently, disaster communications chains utilise email to notify local authorities from centralised disaster monitoring facilities on the mainland. This requires active human engagement, and introduces room for communication difficulties. This approach may be enough for many small-scale emergencies, but in the event that a hazard plays out in multiple locations (including the source of information on the mainland as well as on Saibai), the difficulties in ensuring timely and effective information can be compounded.

According to the UN Office for Disaster Risk Reduction, 'Multi-hazard early warning systems address several hazards and/or impacts of similar or different type in contexts where hazardous events may occur alone, simultaneously, cascadingly or cumulatively over time, and taking into account the potential interrelated effects. A multi-hazard early warning system with the ability to warn of one or more hazards increases the efficiency and consistency of warnings through coordinated and compatible mechanisms and capacities, involving multiple disciplines for updated and accurate hazards identification and monitoring for multiple hazards.'[9]

An interesting characteristic about this particular design area, is that we are dealing with *potential* problems, rather than one that has occurred. This introduces unknowns into the design, and requires being able to entertain a high level of ambiguity. However, there is a great deal of research that indicates responding to anticipated disasters before they happen can not only save lives, it is also cheaper and more effective than responding after an event.

This is an approach promoted at a global level by the 'Sendai Framework on Disaster Risk Reduction', to which Australia is a signatory. The framework points out that 'effective "end-to-end" and "people-centred" early warning systems may include four interrelated key elements:

1 Disaster risk knowledge based on the systematic collection of data and disaster risk assessments;

[9] UNDRR (2024) Early warning system

2 Detection, monitoring, analysis and forecasting of the hazards and possible consequences;

3 Dissemination and communication, by an official source, of authoritative, timely, accurate and actionable warnings and associated information on likelihood and impact; and

4 Preparedness at all levels to respond to the warnings received. These four interrelated components need to be coordinated within and across sectors and multiple levels for the system to work effectively and to include a feedback mechanism for continuous improvement. [10]

As such, this design area is heavily focussed on the close interconnectedness of services and infrastructure. If one of the above components suffers, the whole system is affected. However, the inverse is also true, whereby improvements to one or more elements can have a positive impact on the whole system.

In 2021, TSIRC secured funding to repair existing and install new tidal gauges across the Torres Strait, to accurately monitor and record tide data that can inform our understanding of coastal hazards. So too, efforts are underway to improve rainfall monitoring. Such datasets are highly informative in their own right, but combined together with other available data, there is significant opportunity to improve early warning systems.

⚠ Emergency management in Australia can be complex. Constitutionally, disaster management falls under the responsibility of the states – in this case the Queensland Government. However, local governments, including TSIRC, are often responsible for implementing disaster management measures on the ground. Recognising the need for additional injections of services, support, and opportunity for coordination in times of crisis, the Commonwealth Government established the National Emergency Management Agency (NEMO) in 2023. Authorities at all levels of government will ideally coordinate, though this is not without its challenges.

Design opportunities

6.1 Early warning systems

Opportunity exists to strengthen the integration of hazard monitoring, forecasting, disaster risk assessment, communication and preparedness activities systems and processes. Improving warning systems may for instance involve reducing the need for active human input during times of crisis; or building robustness and redundancy into systems automation; or other such measures. The objective is to enable communities, businesses, government agencies and other actors to reduce the impact of disaster through improved, timely warnings.

→ Early warning systems are deeply interconnected with many walks of life, and could be integrated with many other design areas listed in this brief.

6.2 Remote monitoring and diagnostics

Often, engineering solutions installed in remote locations can be challenging to access regularly and promptly, particularly in the wet season. It is often expensive and time consuming for technicians to understand when preventative maintenance is required at one site and how this should be scheduled relative to other sites. In addition, a critical challenge for appropriate design is the sheer cost of mobilising technical expertise to site to resolve system breakdowns in a timely manner. In this design area, teams may work to develop an online/offline remote monitoring and

[10] UNDRR (2015) Sendai Framework for disaster risk reduction 2015-2030

diagnostics tool that can be used to simplify and/or or improve the efficiency of operation and maintenance programs for infrastructure, such as communication technologies, pumps, treatment plants, battery systems, lighting, and other infrastructure.

→ There may be opportunity here to support waste management, including remote management of coastal waste accumulation, or environmental management.

6.3 Language, knowledge preservation, and digital education tools

This design area presents opportunities to development digital tools tailored to the Saibai context. Whether focused on making information accessible to local communities in familiar language, the preservation of knowledge and histories, on waste management, or another area important to the community (as identified in this brief), such initiatives will aim to leverage information communication and technology for the benefit of Saibai residents.

→ There may be opportunity to integrated with other areas where traditional knowledge is at risk of being lost, such as agriculture or climate.

Additional information

- TSIRC, TSRA (2024) 'Yumi Safe: Safer communities one-stop dashboard'
- Bureau of Meteorology (2024) 'Queensland weather and warnings'
- TSIRC (2022) 'Torres Strait Local Disaster Management Plan'
- UNDRR (2024) 'Early warning system'
- Pacific Resilience Partnership (2016) 'Framework for Resilient Development in the Pacific'
- UNDRR (2015) 'Sendai Framework for Disaster Risk Reduction'
- Keeping Our Mob Climate Safe (KOMCS)

Left: Telstra telecommunications tower on Saibai