Technical Appendix 1

Sustainability Assessment and Risk Assessment

December 2020

Sustainable Masig

Decarbonisation of Great Barrier Reef Islands – Whole of Community Pilot Project

EARTHCHECK

TABLE OF CONTENTS

List of figures iii

List of tables iv

Glossary v

Executive Summary 1

1 Sustainability Assessment Methodology 7

1.1 Preparatory Planning and Stakeholder Mapping 7

1.2 Desktop Research 8

1.3 Stakeholder Engagement 9

1.4 Site Visits 10

1.5 Data Collection Process 12

1.6 Data Assessment 15

1.7 Data Quality and Tracking 15

1.8 Data and Scope Assumptions 16

2 Carbon Emissions 17

3 Energy 19

3.1 Energy Generation and Consumption 19

3.1.1 Overview of Energy Generation and Consumption 19

3.1.2 Energy Generation 23

3.1.3 Solar Profile 24

3.1.4 Energy Consumption 25

3.2 Energy Efficiency 25

3.2.1 Overview of Energy Efficiency 25

3.2.2 Energy Efficiency Practices 25

3.2.3 Building Types and Design 26

4 Water Use and Wastewater Treatment 26

4.1 Overview of Water Consumption 27

4.2 Water Consumption 29

4.3 Wastewater Management 32

5 Waste and Recycling 34

5.1 Overview of Waste Management 34

5.2 Waste Disposal 36

5.3 Reduction, Re-use and Recycling 39
6 Transportation 41
6.1 Overview of Transportation 41
6.2 On-island Transport 42
6.3 Public Transport 44
6.4 Marine Transport and Barges 44
6.5 Air Travel 45
7 Resilience and Self-Sufficiency 47
7.1 Overview of Resilience 47
7.2 Resilience and Climate Change on Masig 49
7.3 Experienced Events 51
7.4 Climate Change Projections 53
7.4.1 Hot days 53
7.4.2 Heatwaves 53
7.4.3 Precipitation 54
7.4.4 Floods 54
7.4.5 Resilience of Island Infrastructure 55
7.4.6 Projected Climate Change Impacts 55
7.5 Community Preparedness and Self-sufficiency 57
7.6 Disaster Planning and Evacuation Arrangements 59
7.6.1 Insurance Profile 60
8 Risk Assessment 61
8.1 Introduction 61
8.2 Methodology 61
8.3 Analysis 64
Bibliography 67
Appendix 1 Masig Island Communication and Engagement Plan 70
Appendix 2 Masig Island Risk Assessment 91

LIST OF FIGURES

Figure 1: Decarbonisation of the Great Barrier Reef Islands – Whole of Community Pilot Project phases 1
Figure 2: Sustainability assessment methodology 7
Figure 3: Masig Island infrastructure map 12
Figure 4: Carbon emissions profile 17
Figure 5: Energy consumption profile based on an average year 19
Figure 6: Comparison of residential and non-residential electricity consumption based on an average year. 21
Figure 7: Daily energy demand over a 24-hour period (2019) 22
Figure 8: Average daily energy demand per month (2019) 22
Figure 9: Electricity consumption on Masig Island compared with the Queensland average[10] 24
Figure 10: Water infrastructure Masig Island 28
Figure 11: Comparison of water consumption between residents and businesses (2018/19 FY) 30
Figure 12: Masig June-July daily consumption for the dry and wet seasons 31
Figure 13: Residential water consumption on Masig Island compared with the Queensland average (2016/17 FY) 32
Figure 14: Map of the Torres Strait biosecurity zones 35
Figure 15: Car bodies on Masig Island 35
Figure 16: Disused boat hull on Masig Island 36
Figure 17: Waste collection truck on Masig Island 36
Figure 18: White goods and large waste items on Masig Island 37
Figure 19: Waste disposed to landfill profile (2019) 38
Figure 20: Waste disposed on Masig Island compared with the Queensland average (2016/17 FY) 39
Figure 21: Crayfish crates made from recycled materials 40
Figure 22: Transport method employed to get to work (2016) 41
Figure 23: Transport fuel usage profile 42
Figure 24: Masig Island household vehicle ownership (2017) 43
Figure 25: Fuel consumption (L) related to on-island transportation based on an average year 43
Figure 26: Fuel reserves and helicopter landing area on Masig Island 46
Figure 27: Project team members with the Masig seasonal calendar 48

Figure 28: Projected changes in annual mean temperatures and annual hot days for the Torres Strait Island Regional Local government area....53

Figure 29: Projected changes in frequency and duration of heatwaves for the Torres Strait Island local government area....54

Figure 30: Projected changes in annual precipitation for the Torres Strait Island Regional local government area....54

Figure 31: Projected frequency and duration of floods for the Torres Strait Island Regional local government area....55

Figure 32: Map of natural hazards on Masig Island (Planning scheme for the Torres Strait Island Regional Council area, 2015)....56

Figure 33: Map of coastal hazards on Masig Island (Planning scheme for the Torres Strait Island Regional Council area, 2015)....56

Figure 34: Highest astronomical tide (HAT) level and sea level rise scenarios....57

Figure 35: How the risk assessment fits into the project methodology....61

Figure 36: Risk profile for Masig Island....64

Figure 37: Risk breakdown for Masig Island....64

LIST OF TABLES

Table 1: Acronyms....v

Table 2: Units....vi

Table 3: Terms....vii

Table 4: Data collection methods for sustainability assessment....7

Table 5: Community engagement activities and persons engaged....10

Table 6: Data collection methods....13

Table 7: Scope and data assumptions....16

Table 8: Masig Island's perceived resilience (2013)....50

Table 9: Experienced events in the Torres Strait (2016)....52

Table 10: Key project theme's correlation to EarthCheck's Destination Standard key performance areas....61

Table 11: Severity evaluation....62

Table 12: Likelihood evaluation....63

Table 13: Risk evaluation matrix....63

Table 14. Summary of potential impacts with little to no mitigation strategies observed....65

GLOSSARY

Table 1: Acronyms

Acronym	Definition
ABS	Australian Bureau of Statistics
AC	Air conditioning
ADF	Australian Defence Force
ATM	Automatic teller machine
CDP	Community Development Program
DES	Department of Environment and Science
CHAS	Coastal Hazard Adaptation Strategy
DATSIP	Department of Aboriginal and Torres Strait Islander Partnerships
DHPW	Department of Housing and Public Works
EFTPOS	Electronic funds transfer at point of sale
EV	Electric vehicle
FY	Financial year
GBR	Great Barrier Reef
GHG	Greenhouse gas
HAT	Highest Astronomical Tide
IBIS	Islander Business, Industry and Service
LPG	Liquefied petroleum gas
NA	Not applicable
PBC	Prescribed body corporate
QTIC	Queensland Tourism Industry Council
RICES	Remote and Isolated Communities Essential Services
RCP	Representative concentration pathways
RES	Regional Economic Solutions
Solar PV	Solar photovoltaic
STP	Sewage treatment plant
TSIRC	Torres Strait Island Regional Council
TSRA	Torres Strait Regional Authority
WTP	Water treatment plant

Table 2: Units

Measurement	Symbol	Meaning
Area	m^2 km^2 ha	Square meter Square kilometer Hectare
Temperature	^oC	Degrees Celsius
Carbon Emissions	tCO_2-e $kgCO_2$-e	Tonne of Carbon dioxide equivalent Kilogram of Carbon dioxide equivalent
Energy	MJ GJ TJ kWh MWh	Megajoule Gigajoule Terajoule Kilowatt hour Megawatt hour
Mass	Kg T	Kilogram Tonne
Solar panel power rating	Wp kWp kW	Watt peak Kilowatt peak Kilowatt
Speed	m/s	Meter per second
Volume	L kL ML M^3	Litre Kilolitre Megalitre Cubic metre

Table 3: Terms

Term	Definition
Blackouts	The loss of electrical power to users
Brownouts	Extended drop in energy voltage
Compost	Convert organic material waste into nutrient-rich substance
Decarbonise	Reduce the amount CO2 (or CO2 equivalents) emitted by an activity or a process
Ecosystem	A biological community of interacting organisms and their environment
Energy efficiency	Using less energy to provide products and services
Isolated power supply	A power grid which is not connected to other power systems
Passive building design	Buildings designed to naturally circulate air and cool during the summer and retain sunlight heat during winter
Per capita	Per capita is equivalent to 365 full person days. This activity measure incorporates only resident populations, sourced from the Australian Bureau of Statistics census in 2019. It excludes visitors as this data was not available at the time of this report.
Potable water	Water that is safe to drink and use for food preparation
Qualitative data	Can be observed and recorded. It is usually not numerical, and collected through methods of observations, one-to-one interviews, conducting focus groups, and similar methods.
Quantitative data	Information and numbers which describe something in a detailed manner
Recycle	Convert waste into a reusable material
Resilience	The capacity to recover and rebuild after a traumatic event
Severe weather event	Dangerous weather with the potential to cause damage or social disruption
Solar Photovoltaic (PV)	Technology which converts sunlight into electric current
Sustainability	Resources are consumed in a responsible manner and maintained for future generations while ensuring environmental, social and economic balance
Sustainability theme	The five sustainability themes for this project are energy, waste, water, transport and resilience
Waste stream	Flows of specific kinds of waste from the source to recycling or disposal
White goods	Large electrical domestic goods (refrigerator, washing machine, etc.)

MASIG ISLAND SUSTAINABILITY AND RISK ASSESSMENT

EXECUTIVE SUMMARY

The sustainability assessment represents the first phase of the Decarbonisation of the Great Barrier Reef Islands – Whole of Community Pilot Project, as presented in Figure 1. The aim of this project, run by EarthCheck in partnership with Arup, Regional Economic Solutions (RES) and Queensland Tourism Industry Council (QTIC), is to provide Masig Island with community-led contextually and culturally appropriate project options for decarbonisation and resilience-building.

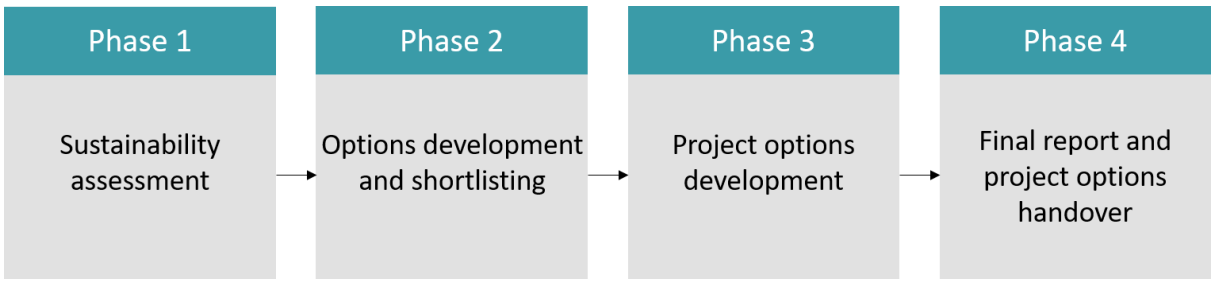

Figure 1: Decarbonisation of the Great Barrier Reef Islands – Whole of Community Pilot Project phases

The sustainability assessment phase commenced on the 24th of June 2019 and was carried out in the following order:

- Project preparation and planning;
- Desktop research on Masig Island;
- Engagement with key contacts (on and off-island);
- Island visit (10th, 11th and 12th of September 2019);
- Data assessment; and
- Sustainability reporting (this report).

The sustainability assessment focussed on developing a whole-of-community sustainability profile across the five key themes of energy production and efficiency, water and wastewater use, waste management, transport and resilience. Based on these findings, the whole-of community carbon emissions profile was developed as a benchmark for Masig Island.

The findings from this sustainability assessment helped to identify opportunities for decarbonisation and resilience-building. The results from this first project phase were used to inform the development of a preliminary long list of emission reduction options. Further community consultation, options analysis and the gateways process tested these options to identify projects with the highest feasibility and likelihood, developing these into final project options.

Sustainability Assessment Key Findings

Masig Island, also known as Yorke Island, is a coral cay located in the central island group of the Torres Strait. The island is located 150km northeast of Thursday Island, which is situated just off

the tip of Cape York. It is approximately 2.7km in length and 800m at its widest point with a total area of 1.62km^2. The Traditional Owners of Masig, the Masigalgal people, are traditionally skilled navigators with detailed knowledge of the area and occupy a central position in the Strait's trading network. The key industry sectors and employers on Masig Island are public administration and safety, followed by education and training. The fishing industry is also a major economic driver for the community. It is a hub for many of the east coast fishing and prawn boats and it also plays a large part in the livelihood and culture on Masig.

A long and ongoing connection with land and sea, where traditional knowledge remains central to the culture, Masig islanders have a high awareness of sustainability, self-sufficiency, and the impacts of climate change. Islanders lead a lifestyle where water availability is critically dependant on desalination, and access is severely limited during key times of the year, while islanders themselves use less than 20% of energy consumed by average Queenslander.

Masig Island has long been a pioneer in terms of sustainability in the Torres Strait region. Land and sea management have been a priority for this community which traditionally strongly relies on its environment for culture and sustenance. Because of this, the community is motivated to plan for the future and develop a more self-sufficient lifestyle which will maintain the ecosystem in which it inhabits, as has long been the traditional and cultural way of life.

Based on the conversations held as part of the sustainability assessment process, community members are engaged and eager to execute small-scale projects and ideas and harness the success of "easy win" projects to drive change throughout the Torres Strait region. Many residents are enthusiastic about the idea of change and new projects being implemented, while preferring to see things in action before they choose to implement them in their own households or communities.

For projects to be successful, decarbonisation and resilience-building efforts need to generate tangible and proven results in terms of quality of life improvements, economic development and the bolstering of the cultural connection between the Masig Island community and their land and seas.

The whole of community emissions profile*:* Masig Island's community carbon emissions, as calculated by this sustainability assessment, are calculated as **2,848 t CO2-e** for the Masig community for an average year[1]. This equates to per capita emissions of **10.5 t CO2-e** per year for Masig residents, with a high portion of community emissions being related to transport (barges and flights). By contrast, average emissions per capita for Australia is 15 t CO2-e and Queensland per capita emissions are 32 t CO2-e, with transport representing a much smaller proportion of per capita emissions.

[1] *An average year for carbon emissions is the modelled year based on a combination of components (i.e. electricity, transport and waste) calculated using different timeframes dependent on the data that was available at the time of writing this report. This will be detailed further in subsequent sections.*

Energy generation and efficiency

- ***Community sentiment:*** The community highlighted the need for more diversified back-up power sources such as solar to improve reliability during times of uncertain weather events, which in turn would increase resilience.
- ***Energy generation:*** Energy is generated by four diesel generators. This isolated power supply is thought to be at capacity for the current population. This isolated power supply has just enough capacity for the current population and residents have limitations on consumption. This has been identified by community as a barrier for local and tourism development.
- ***Power cards:*** Community members pay for energy with a power card on a "pay-as-you-use" basis. Cards can be issued to individuals or to a specific address.
- ***Cost of energy:*** The cost of energy is a burden for the community even though the Community Service Obligation (CSO) ensures similar pricing as the rest of the state, as average wages on the island are lower than the rest of the state. Different community organisations provide power card top ups to people in need.
- ***Energy upskilling:*** Based on community testimony, there is limited technical knowledge within the community to manage or upgrade existing solar assets due to qualified workforce moving to the mainland for work.
- ***Solar hot water:*** Solar hot water panels are found on approximately 81% of houses in the community.
- ***Solar PV:*** Limited solar photovoltaic (PV) installations on the island, only the Islander Business, Industry and Service (IBIS) shop and desalination plant each have 10kW photovoltaic systems. There is some solar lighting near the jetty, but not enough to provide a safe working environment.
- ***Energy efficient practices***: There is significant community support for building improvements, education and job opportunities around energy efficiency practices.
- ***Building types and design***: Housing is compliant with Queensland Government construction codes but does not consider sustainable design concepts and are reported being very hot in summer. Older homes are reported being more adapted to Torres Strait conditions and more comfortable to live in.

The total energy consumption for the Masig Island community was evaluated on average to be at **39,876GJ** per annum[2] or **147.7GJ** per capita.

Water

[2] *An average year for energy consumption is based on a combination of components (i.e. electricity, solar, LPG and transport) calculated using different timeframes dependent on the data that was available at the time of writing this report. This will be further broken down in the Energy section.*

- **Community sentiment:** Water is a constant issue for the community due to limited treatment capacity and reserves. Masig has been and continues to be part of water-metering and efficiency projects.
- ***Water supply***: The water supply is almost exclusively provided by the desalination plant (70kL and 50kL per day systems), supplemented by rainwater (from the water reservoir and homes) as well as barged-in bottled water.
- ***Water restrictions:*** The community is faced with water shortages and restrictions for several months of the year during the dryer season. During restriction periods, residents have access to water for 9 hours a day on weekdays and 16 hours a day on weekends.
- ***Water efficiency***: The Masig community has been exposed to water efficiency and education through multiple programs such as the PowerSavvy and the Remote and Isolated Communities Essential Services (RICES) project. Smart water meters have helped the community reduce their water consumption by up to 39% over 12 months ending in 2019.
- ***Well water:*** Masig has approximately 33 wells spread throughout the island. The water from these is not potable, as it is brackish and contains sediments. Some wells are outfitted with pumps to provide irrigation water.
- ***Rainwater:*** Most homes have a rainwater tank (81%), which is often the preferred water for consumption due to reasonable taste (no chlorine). Some homes even have two tanks or a dual-purpose tank which are filled with mains water during non-restricted hours, enabling residents to have a "24-hour" water supply.
- ***Wastewater treatment:*** The current wastewater treatment plant can support 545 persons (only 270 currently on Masig). It estimated by Torres Strait Island Regional Council (TSIRC) that 60kL of wastewater is treated daily. Council does not measure the quantities of sludge produced, but it is dried and disposed of in the designated area at the waste management site.

The total water consumption for the Masig Island community for the 2018/19 FY was **35,400kL** per annum or **131kL** per capita[3].

Waste

- ***Community sentiment:*** Waste management is an important issue for the community, due to space limitations and the high costs associated with waste removal (transport and biosecurity). The waste management site is rapidly reaching maximum capacity.
- ***Waste management:*** Waste is separated into general waste, green waste, white goods and electronics at the waste management site. General waste and green waste are disposed of in the landfill sites.

[3] (Torres Strait Island Regional Council, 2019)

- ***Car bodies:*** A significant number of old car bodies are strewn across the island. Biosecurity restrictions and extremely high costs of removal has been an obstacle for removing these.
- ***Recycling and reuse:*** The school has implemented a container recycling program, in collaboration with SeaSwift. This is the only recycling initiative on the island. Residents often reuse and repurpose materials such as wood, metal, old boats and buoys to make furniture, art and crayfish cages.

The total waste disposed to landfill for the Masig Island community in 2019 was **509m^3** or **1.9m^3** per capita[4].

Transport

- ***Community sentiment:*** Transport to and from the mainland is expensive. A Local Airfare Scheme (fixed discount) is offered to all Torres Strait residents, but due to Masig being one of the furthest islands in the region, prices remain high.
- ***On-island transportation****:* Residents travel by foot, bicycle and car and there is no public transport on Masig. It is estimated that there are up to a total of 40 vehicles on Masig and that 62.5% of households do not own a vehicle.
- ***Transport costs:*** Transportation costs of freight (marine and air) are high due to its remote location. Sometimes these services are stopped during high winds which present isolation and supply issues for the community.
- ***Air transport:*** Air transport is the only way to get to Masig Island, with both scheduled and chartered flights used (45-minute flight between Masig and Thursday Islands). The island is home to one of two CASA approved airstrips in the Torres Strait.
- ***Marine transport:*** Residents travel between nearby islands using small boats and dinghies. Almost all goods are barged to Masig on a bi-weekly schedule.
- ***Services:*** The health and social services available to the community are often located on the mainland or neighbouring islands such as Thursday Island.

Resilience

- ***Community sentiment:*** The community identified reducing erosion, sand loss as well as developing strategies to manage king tides and storm surges as critical issues. There is a strong desire throughout the community to be given the means to maintain the island themselves, based on traditional knowledge of the land.
- ***Culture and tradition:*** The survival and continuing use of traditional and cultural knowledge and practices are critically important to the community. The Torres Strait Regional Authority (TSRA) and the prescribed body corporate (PBC) are currently involved in projects on this front (seasons calendar and knowledge-sharing).
- ***Fossil fuel dependence:*** Community resilience is closely tied to energy security and fuel supply, as electricity is generated on-island with diesel generators.

[4] *Waste data provided by A. Prince Consulting (APC), current as of 2019.*

  - The community is dependent on energy for its fresh water supply which is provided from a desalination plant and circulated around the island via electric pumps.
  - The community relies on energy for communication and banking services (electronic funds transfer at point of sale (EFTPOS) and cash withdrawal).
- ***Climate change and severe weather events:*** The island is extremely vulnerable to the impacts of climate change, with sea level rise predicted to have the most significant impacts. Due to its northerly latitude, the Torres Strait region is less likely to be impacted by tropical cyclones, though the island has been affected by cyclones in the past. During storms, the community can be isolated for up to four weeks.
- ***Funding and projects:*** Masig is involved in the QCoast2100 project through TSIRC and $20 million of funding was recently approved for erosion control projects with TSRA.

1 SUSTAINABILITY ASSESSMENT METHODOLOGY

Figure 2 below illustrates the main steps included in the sustainability assessment. The five themes of energy generation and efficiency, water, waste, transport and resilience were assessed.

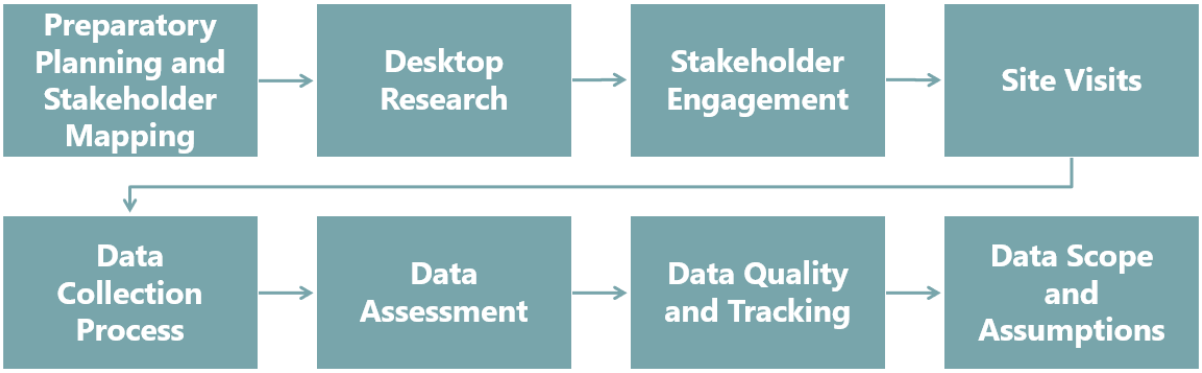

Figure 2: Sustainability assessment methodology

1.1 Preparatory Planning and Stakeholder Mapping

The project team defined the scope and method of approach for the five key themes of energy generation and efficiency, waste, water, transport and resilience. During the preparatory planning and stakeholder mapping steps, the project team identified stakeholders and groups to engage with. These were captured in the stakeholder register (containing names, organisations, positions, email addresses, phone numbers as well as a communication log) which was updated throughout the project to account for evolving relationships and changes (see Appendix 1: Masig Island Communication and Engagement Plan).

To collect the desired data, a wide-ranging and flexible data collection strategy was needed due to the high number and variety of stakeholders involved in the project, including the sustainability assessment. For this reason, a suite of data collection methods were developed for this project, which are defined in Table 4.

Table 4: Data collection methods for sustainability assessment

Data collection method	Approach and sustainability assessment outcome
Third party reports and data	Operational data, statistics, reports, etc., were obtained from a range of stakeholders including TSIRC, Ergon, SeaSwift, TSRA and other key contacts. This also included research papers and publicly available documents. This information was gained through information requests sent to the concerned parties alongside desktop research.
Survey	A survey targeting the project's five key themes was distributed to the Masig Island community before the second visit (December 2019). Key contacts included the island's operational team, the

	TSIRC Masig Island office staff and the TSRA Member for Masig Island. No surveys were returned to the project team during the second visit. As a result, this data collection method was discounted. Potential reasons for this lack of promotion with and engagement from the community may include restricted internet access (for internet format), and the survey format (length and complexity).
Interviews	Interviews consisted of one-on-one or small group discussions about the five sustainability themes. Information was captured by note-taking. All field notes were collated in a central Sustainability Assessment OneNote document.
Drop-in sessions	Drop-in sessions allowed the project team to meet community members and other stakeholders, build relationships and promote the project. All-day drop-in sessions were held at the community hall on the island on 10, 11 and 12 of September 2019. Drop-in sessions were also held on the 8, 9 and 10 of December 2019 covering activities for both phase 1 (sustainability assessments) and phase 2 (Options longlist).
On-island visits	On-island visits allowed the project team to collect detailed qualitative and quantitative information on the project's five key themes. Buildings, infrastructure, equipment, etc. were visited during an island-wide tour conducted by TSIRC. All field notes were collated in a central Sustainability Assessment OneNote document.
Photographs	Photographs were taken to provide context to the collected data. Photographs of private property and people were only taken where permission was granted.

1.2 Desktop Research

A desktop research and literature review were undertaken to develop understanding around the history, culture, demographics, infrastructure, facilities and future development of Masig Island.

The review encompassed secondary information including reports, existing data and previous studies on the island and the region as well as other publicly available information to inform the following steps of the assessment.

The desktop research informed the background and provided the foundations for the key themes of the sustainability assessment.

Among others, key documents included in the literature review were:

- Exploring community-based water management options for remote Australia (RICES project)

- Identifying and understanding the drivers of high water consumption in remote Australian Aboriginal and Torres Strait Island communities
- Masig (Yorke) Island Planning Scheme (TSIRC)
- Torres Strait Local Disaster Management Plan (TSIRC and Torres Shire Council)
- Adapting to sea-level rise in the Torres Strait (CoastAdapt)
- Masig Yesterday, Today and Tomorrow: Community Future Scenarios and Adaptation Strategies (Australian Government and Reef and Rainforest Research Centre)
- Draft Masig Community Climate Change Adaptation and Resilience Plan

1.3 Stakeholder Engagement

The project team was introduced to key state government contacts from Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP) by DES. DATSIP then introduced the team to local council contacts and other key on-island contacts. The project team was introduced to local government contacts from the TSIRC and other key on and off-island contacts such as TSRA, SeaSwift, Ergon Energy and other community organisations.

RES led the project team with the engagement of First Nation communities and Traditional Owners of Masig Island. RES's approach involved reaching out to community members, elders and community leaders (by phone or face-to-face) through family connections or acquaintances to build trust-based relationships with community. In some instances, RES established contact with local communities while on other business near the islands. This process enabled project knowledge and buy-in to be developed prior to the sustainability assessment visit, not only accelerating the consultation process, but displaying respect and due process for First Nation community engagement. The relationships between the project team and the island community were developed and strengthened throughout the various project phases and island visits. The RES multi-layered engagement approach rested on local knowledge, community-based networking and relationship building. Following-up and staying in touch with key members of the community was essential to maintaining project engagement and aimed to ensure participation in the upcoming phases.

An operational team was established to help the project progress in a pertinent and impactful manner, promote local ownership of the project and ensure strategic alignment with other programs. The operational team constituted of the following community representatives:

- John Morris (PBC chair)
- Ned Mosby (Local Police chief)
- Fraser Nai (TSIRC Councillor)
- Hilda Mosby (TSRA Member for Masig Island)
- John Rainbird (TSRA)
- Zoe Burns (Energy Queensland)
- Vitali Belokoskov (Energy Queensland)
- Kirsten Lovejoy (Department of Environment and Science)
- John Conroy (Department of Aboriginal and Torres Strait Islander Partnerships)

Due to project constraints, the operational team was implemented in November 2019. Meetings were held in November 2019 and in January 2020. Subsequent meetings were cancelled due to council elections and then the COVID-19 pandemic. These competing community priorities and unforeseen circumstances required an adjustment of the consultation approach.

Finally, a follow-up and communications register was implemented to further enhance and develop relationships between the project team and key community stakeholders. Communications with stakeholders were noted and reported back to the community as well as involved DES and DATSIP officers.

1.4 Site Visits

The project team visited Masig Island to collect quantitative and qualitative data on the 10th to the 12th of September 2019. To complete the sustainability assessment and address any remaining information gaps, further data collection was conducted during the second island visit between 7th and 11th of December 2019.

Community engagement activities were held during both island visits. The Table 5 below lists the type of engagement activity, dates, location as well as an approximation of persons engaged during each activity.

Table 5: Community engagement activities and persons engaged

Date	Location	Activity	Persons engaged
9.09.2019	Community Hall	Drop-in session	16
10.09.2019	Community Hall	Drop-in session and school meeting	30
11.09.2019	Community Hall	Drop-in session	20
7.12.2019	Community Hall	Concert	50
8.12.2019	Community Hall	Prayer, community lunch and drop-in session	20
9.12.2019	Community Hall	Drop-in session	5

In preparation for the island visits, posters advertising the project purpose and drop-in session schedule were circulated throughout the community via TSIRC and TSRA. These were printed by on-island contacts and displayed in key areas (the Council office, digital noticeboard). Additionally, project flyers presenting the methodology (different project phases and scope) were used as a presentation tool to guide discussions. These were printed out and distributed during drop-in sessions.

Once on-island, RES led community engagement and held multiple meetings and informal conversations with the community. This process involved RES leading casual conversations with community members. This personal relationship building was critical to constructive community engagement and overall project success.

During the island visits, TSIRC and TSRA took the project team around key facilities and infrastructure on-island. Council provided the project team with relevant information regarding infrastructure under the various themes. The sites visited included:

- Council offices
- Desalination plant
- Wastewater treatment plant
- Jetty and boat ramp
- Erosion and sand loss/accumulation hotspots
- Various road infrastructure around the island
- School (Tagai State College)
- Shops (IBIS and Kozan)
- My Pathway building
- Airport and helipad
- Ergon generator plant

Drop-in sessions were held at the Community Town Hall, where residents had the opportunity to meet the project team, find out more about the project, provide information about life on the island, highlight issues around the five key themes relating to Masig Island as well as identify potential solutions or projects in line with identified challenges. These drop-in sessions were set in a casual setting in the town hall. A circular seating arrangement allowed for all parties to be present in the discussion and be more at ease. During both visits, the drop-in sessions were held from 9:00am to 4:30pm for the three days of each visit.

The consultation process on Masig Island was unique due to its small size and relatively small population. 66 people were met with during the sustainability assessment, accounting for more than one fifth of the island's population. A further 75 people were met with during the second visit (Options Longlist). Many of these were previously involved in the sustainability assessment.

Due to the COVID-19 pandemic, the third trip (project options review), scheduled from the 17th to the 20th of March 2020 was cancelled. The remote consultation was conducted with three community members and other stakeholders on the 25th of June 2020. The fourth and final visit, planned for June 2020, has also been cancelled due to continued travel restrictions and community health considerations. The delivery of the project outcomes will be conducted remotely throughout November 2020.

1.4.1 Island Infrastructure

Energy, water, waste and transport infrastructure have been mapped in Figure 3. The desalination plant and seawater bores are located at one end of the runway. Other water infrastructure includes the water treatment and storage which is located between the runway and the town. The wastewater treatment site is located on the western side of the island, south

of the landing strip. The ferry and barge terminal is on the north side of the island, near the runway. On the east side of the island is the waste management site. In the town area is the isolated power station. Community consultations were held in town at the Community Hall.

Figure 3: Masig Island infrastructure map

1.5 Data Collection Process

The sustainability assessment data collection process was led by EarthCheck (supported by RES and QTIC) and targeted the five key areas of energy (generation and efficiency), water (supply and treatment), waste, transport (inter and intra-island), and resilience to the effects of climate change. All data and information were collected through one or many of the data collection methods outlined in

Table 6.

Table 6: Data collection methods

Sustainability Theme	Description
Energy	**Consumption and Generation** The energy data scope relates to on-island energy production (non-renewable and renewable) as well as energy usage. Energy production figures (FY 2015-2016, 2016-2017 and 2017-2018) for the diesel genset as well as the domestic/organisational split in energy consumption were obtained through Ergon Energy. The data obtained from Ergon Energy was used to develop energy demand graphs to illustrate monthly energy demand as well as over a 24-hour period. No energy consumption data was obtained from the community, as they employ rechargeable electricity cards and do not possess detailed information around energy usage. The information garnered around this was a broad estimate of how long a $20 or $50 charge would last a family. This is discussed in more detail in the energy efficiency section. Energy data was measured and collected in a range of units and figures were converted into GJs for presenting all results, performance measures and comparisons (except for demand which is presented in kW). **Energy Efficiency** The energy efficiency data relates to energy reduction systems and initiatives as well as energy consumption behaviours. Information around this theme comprised of project team observations during the site visits, conversations and meetings with stakeholders and community input provided during the drop-in sessions. Limited quantitative data was obtained or available for this theme. The energy efficiency data obtained (various timeframes) was measured and collected in a range of units and figures were converted into GJs for presenting all results, performance measures and comparisons (except for demand which is presented in kW).

Water	This area addressed potable water production (desalination), sewerage treatment/management, water consumption as well as water usage reduction/efficiency measures and practices. Data around potable water production and wastewater management was obtained through TSIRC, who manage the infrastructure. Information around water consumption and water usage reduction/efficiency measures and practices was obtained through third party reports and data, interviews, the drop-in sessions as well as the project team observations during site visits. Water consumption was measured in kilolitres (kL).
Waste	The waste management data relates to on-island waste generation, waste management as well as recycling and materials re-use initiatives. All waste is managed at the waste management site. Waste quantity figures were obtained through TSIRC as well as the consultants (APC Waste Consultants) running a DES waste program in Indigenous communities (Queensland Indigenous Waste Strategy, Waste Management Situational Analysis). The carbon footprint of waste disposal was evaluated based on the EarthCheck Benchmarking software using general waste incineration benchmark data. Waste production was measured and reported in cubic meters (m^3).
Transport	The transport sustainability assessment targeted three main transport types: on-island transport (including vehicles, walking and alternative transport methods), marine transport (including barges and fishing boats) as well as air transport (including scheduled and charter flights). Data around on-island transport was obtained through Australian Bureau of Statistics (ABS) data on vehicle registrations, council information, information from interviews with community members during the drop-in sessions as well as project team observations. Air transport data was obtained through a desktop review of flight schedules and benchmark fuel consumption statistics as well as guidance from a charter flight operator operating in the Torres Straits. For the scheduled flights, the island is serviced by routes connecting with other islands. The whole loop was considered as part of the transport profile and included in the island's carbon profile. Data for marine transport was obtained from the barge operator servicing Masig Island as well as the government boat registrations register. Masig Island is serviced by routes connecting with other islands. The whole loop was considered as part of the transport profile and included in the island's carbon profile.

	Transport data was measured and collected in a range of units and was converted into litres for presenting all results, performance measures and comparisons.
Resilience	For the purpose of this project, the community's resilience was evaluated through a climate resilience and self-sufficiency lens. Essentially, the climate, weather and self-sufficiency issues facing the community were identified and assessed. The data used for this included the Queensland Future Climates Dashboard using scenario representative concentration pathways 8.5 for the Torres Strait region. These were then compared to the community's preparedness, in terms of infrastructure, emergency planning and mitigation measures. This was informed through observation, stakeholder input as well as previous work on the subject, such as the 2013 *Masig Yesterday, Today and Tomorrow: Community Future Scenarios and Adaptation Strategies*. This information, mostly qualitative in nature, was collected by the project team on-island through discussions with community stakeholders. All the data collection methods described in Table 4 were employed. The sustainability assessment findings allowed the project team to assess the community's preparedness to severe weather events and climate change, estimate the capacity to operate in island-mode, as well as provide the context for the developed project options.

1.6 Data Assessment

The quantitative sustainability assessment data collected was assessed using EarthCheck's proprietary benchmarking software, to catalogue, organise and contextualise the information. Detailed profiles were developed for each of the key themes. The use of the benchmarking tool allowed for the modelling of the island's approximate greenhouse gas emissions on a whole-of-island/whole-of-community level as well as for each of the five project themes.

The qualitative data collected as part of the sustainability assessment informed and contextualised the current situation on Palm Island around energy, water, waste, transport and resilience. This assessment set the foundation for the options identified by the project team, community and other key stakeholders, and supported the risk assessment.

1.7 Data Quality and Tracking

Throughout the project, ensuring data quality, traceability, and shareability were key. A data repository and assumptions log (spreadsheet) were used for the collection of all sustainability assessment data. This consisted of a table including the obtained data divided by key area, the data source, as well as accompanying assumptions relating to the information.

All third-party sources (reports, studies, emails, etc.) were collated in a document register to ensure data tracking, identification of knowledge gaps and assumptions as well as facilitation of information sharing through the project team.

1.8 Data and Scope Assumptions

Several informed assumptions defined the scope of the sustainability assessment which are outlined in Table 7 below. Other assumptions specific to each theme are included in the relevant sections below.

Table 7: Scope and data assumptions

Measure	Assumption
Residents	It is assumed there are 270 residents as per the 2016 census data[5].
Residential properties	According to an Ergon Energy representative, it is assumed there are 98 residential dwellings.
Average household size	It is assumed Masig Island has 3.7 persons per household and Queensland has 2.6 persons[6].
Commercial buildings	It was reported by an Ergon Energy representative that there are 26 commercial buildings on Masig Island.

[5] (Australian Bureau of Statistics, 2019)

[6] (Australian Bureau of Statistics, 2017)

2 CARBON EMISSIONS

Total carbon emissions were calculated as **2,848t CO2-e** for an average year[7]. The emissions related to each emission category closely aligns with the energy profile.

The Masig Island emissions profile includes several emissions sources including electricity generation, liquid petroleum gas (LPG) usage, waste sent to landfill, onsite wastewater treatment and transportation (land, marine and air). Figure 4 presents the total emissions broken down by source. The following section provides a summary of the composition of the carbon emissions, with more detailed information and context provided in the individual theme sections.

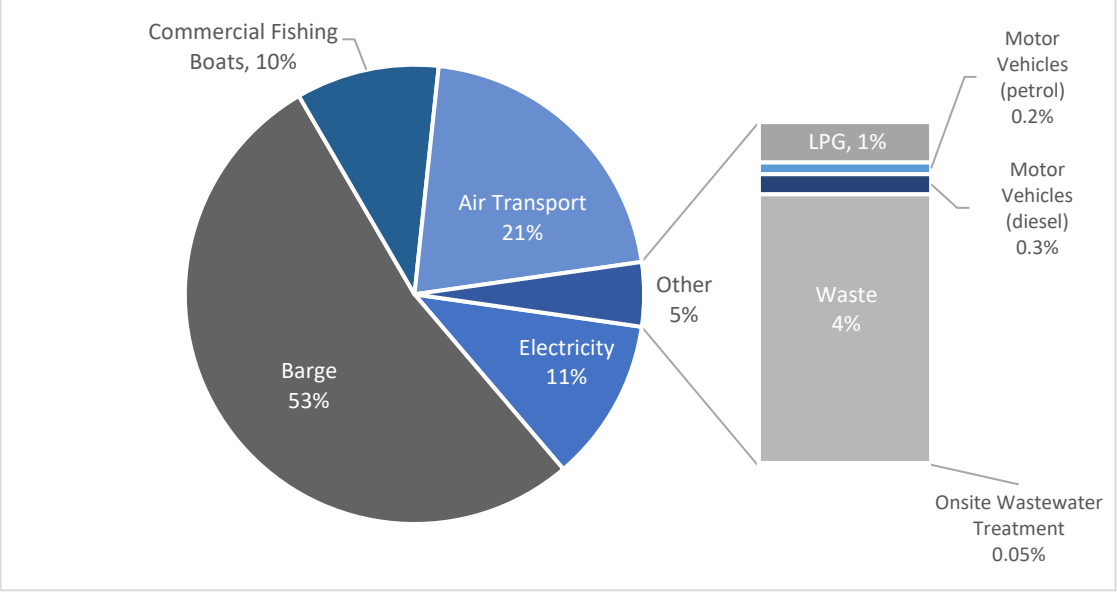

Figure 4: Carbon emissions profile

As Masig Island is located over 1,100 km from Townsville, over 800 km from Cairns and 150 km from Horn Island (air distance), transportation to and from the island by sea and air contributes a significant amount of emissions to the overall carbon footprint of the island. In total, off-island transport corresponds to 84% of total emissions. Marine transport, including barges and fishing boats, make up the majority of the island's emissions, generating 63% of total carbon emissions. It is important to note that Masig Island is serviced by a barge which visits multiple other islands in the Torres Strait. The emissions associated with the whole route were included in the emissions footprint. Marine transport to and from Masig Island, as well as associated carbon emissions, cannot be isolated from this loop, as it is only by servicing multiple islands that this transport service is viable. Air transport emissions include the scheduled Skytrans service as well as charter

[7] *An average year for carbon emissions is the modelled year based on a combination of components (i.e. electricity, transport and waste) calculated using different timeframes dependent on the data that was available at the time of writing this report. For emissions relating to electricity, see section 3. For emissions relating to waste, see section 5. For emissions relating to transport, see section 6.*

flights from various operators. Air transport makes up 21% of carbon emissions. As is the case for the barges, Skytrans provide transport via a loop visiting Masig Island and other nearby Torres Strait Islands. The loop's estimated carbon emissions have been included in the carbon emissions profile. Air transport to and from Masig Island, as well as associated carbon emissions, cannot be isolated from this loop, as it is only by servicing multiple islands that this transport service is viable.

Ergon Energy provides electricity generated by an Ergon Energy diesel power plant located at the corner of Dan Road and Steven Jeff Road. Diesel fuel combustion contributes to a significant release of greenhouse gas emissions but despite this it continues to be used in remote communities due to its low cost and high reliability. Electricity generation represents 11% of Masig Island's total carbon emissions. It should also be noted that energy generation using diesel generators has the potential of causing air quality issues, emitting particulates, and posing certain community health risks. More data is needed in order to assess how Masig is impacted by this, which falls outside of this project's scope.

Masig Island's remoteness as well as biosecurity limitations also makes waste transport and management a complex and expensive issue. It is estimated that waste management and disposal make up 4% of total carbon emissions. LPG comprises 1% of Masig Island's carbon emissions. On island transport accounts for only 0.5% of the island's emissions profile. This can be explained by the short distances travelled due to the island's small size combined with the low number of cars on the island which are expensive to ship over. Finally, water treatment accounts for 0.05% of emissions. This figure corresponds to the estimated emissions associated with sludge storage and disposal. The energy required for the operation of the treatment plant is already considered in the energy emissions.

3 ENERGY

3.1 Energy Generation and Consumption

The following sections provide an overview and background on energy generation and consumption on Masig Island, including energy generation, solar profile and energy consumption. This is compounded by the fact that Masig's energy plant is reportedly at capacity, constituting an inhibiting factor to community development.

3.1.1 Overview of Energy Generation and Consumption

Energy plays a central role in the lives of the local people, as it is used for water desalination and distribution, cooling, lighting, communications and many other essential uses. During community consultations, residents identified energy generation and security as important issues facing Masig Island. This is compounded by the fact that Masig's energy plant is reportedly at capacity, constituting an inhibiting factor to community development.

Beyond electricity consumption, Masig Island's energy footprint consists of several different energy sources. Figure 5 presents Masig Island's energy profile.

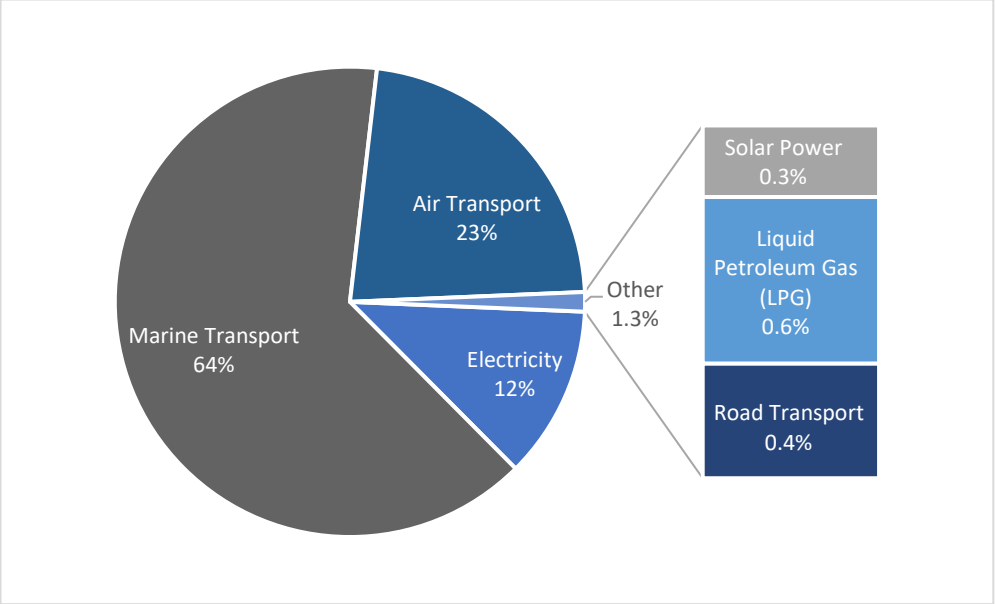

Figure 5: Energy consumption profile based on an average year[8]

[8] *An average year for the energy profile is based on a combination of aspects (i.e. electricity, solar, transport and LPG) that were calculated on the basis of different timeframes as this was the data that was available at the time of writing this report. Electricity is calculated based on the average usage of previous financial years, sourced from Ergon Energy. Solar energy is based on the average number of sunlight hours a year and the current kW of solar systems on the island. For more details on transport related energy, see section 6.*

Marine transport and air transport make up the majority of energy consumption (64% and 23% respectively). This is related to the energy consumed via the fuel consumption of the barges and planes. As detailed further in the transport section, marine and air transport providers operate in loops which service other nearby islands. These whole loops have been considered in the transport related energy consumption profile as they are integral to the service's existence. Electricity production, which powers all on-island equipment such as the desalination plant, refrigeration, lighting and various other utilities is the third most significant energy-consuming activity (12%). Finally, LPG usage accounts for 0.6%, on-island road transport for 0.4% and solar power for 0.3%.

Figure 6 presents the electricity consumption, broken down into residential and non-residential usage. Non-residential energy consumption is significantly higher than residential usage (50% higher). This may be due to a variety of causes. Firstly, the desalination plant as well as the STP are both important energy consuming TSIRC infrastructure (54,188 kWh for FY 18-19 and 35,000 kWh per year respectively). Combined, these two plants make up 11.3% of all non-residential energy consumed on Masig. Secondly, it was observed that most, if not all, non-residential buildings have air-conditioning running throughout the day in order to maintain a cooler environment. Finally, the shops and the health centre are other non-residential energy consumers due to higher refrigeration needs and other electrical devices and equipment. These cooled, non-residential environments may be used by the broader community to escape the heat during hotter months, but precise information around this practice was not available.

In terms of residential energy consumption, the community have highlighted that energy prices account for a significant proportion of the community's budgets, which may limit the amount of energy used as well as how it is used. It is recognised that the high cost of energy may inhibit certain uses and constitutes an obstacle for community development.

Essentially, the different energy needs of many non-residential buildings (technology, lighting, increased cooling),) as well as non-residential buildings providing important services to the wider community building (desalination, public works) combined with the low per capita usage of energy in homes form the main justification for this difference in energy usage.

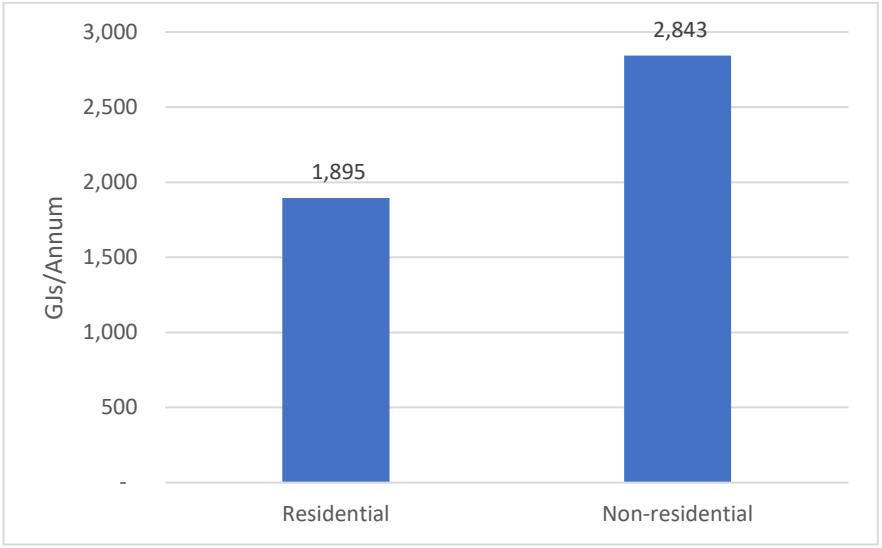

Figure 6: Comparison of residential and non-residential electricity consumption based on an average year[9].

In terms of residential energy consumption, the average household on Masig Island uses less energy than the Queensland average. The average Queensland home uses 24% more energy than the average Masig home[10], even though the average household size on Masig includes over 40% more residents [11] . Consequently, Masig Island's per capita residential energy consumption is also lower than the state average. The annual energy consumption of the average Queenslander is almost 70% higher than the average Masig Islander consumption[10].

Figure 7 illustrates the variations in energy demand over a 24-hour period based on the average daily demand over 2019, according to Ergon Energy. The peak energy demand occurs at 8:00pm. Two smaller demand spikes occur at 8:00am and 1:00pm. The shape of the energy demand curve and the time of the peak demand closely align with typical Ergon Energy patterns[12]. This energy demand variation is closely tied to the daily activities of community members, with the daily peak occurring after work when residents are home and cooking dinner and using air-conditioning (if available).

[9] *An average year for electricity is based on averaging three previous consecutive financial years of data (2016/17FY, 2017/18FY and 2018/19FY) to represent the average usage. Electricity data provided by Ergon Energy, current as of 2019.*

[10] (Australian Bureau of Statistics, 2013)

[11] (Australian Bureau of Statistics, 2017)

[12] (Ergon Energy, n.d.)

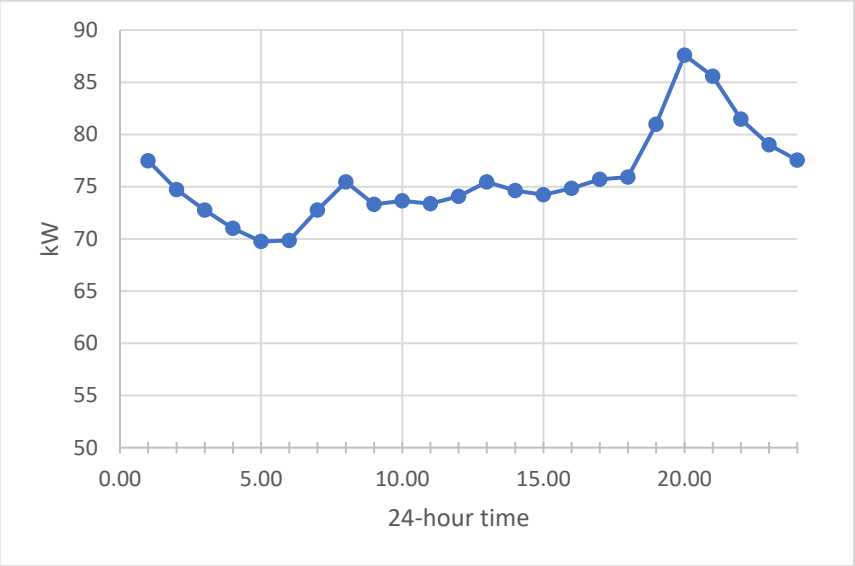

Figure 7: Daily energy demand over a 24-hour period (2019)

As well as varying over a 24-hour period, daily energy demand fluctuates over the year as shown in Figure 8. This consumption profile aligns with annual temperature variations, as the annual (2019) peak demand aligns with the hotter months (November to January). The average daily energy demand across the year is 148.62kW, as seen in Figure 8.

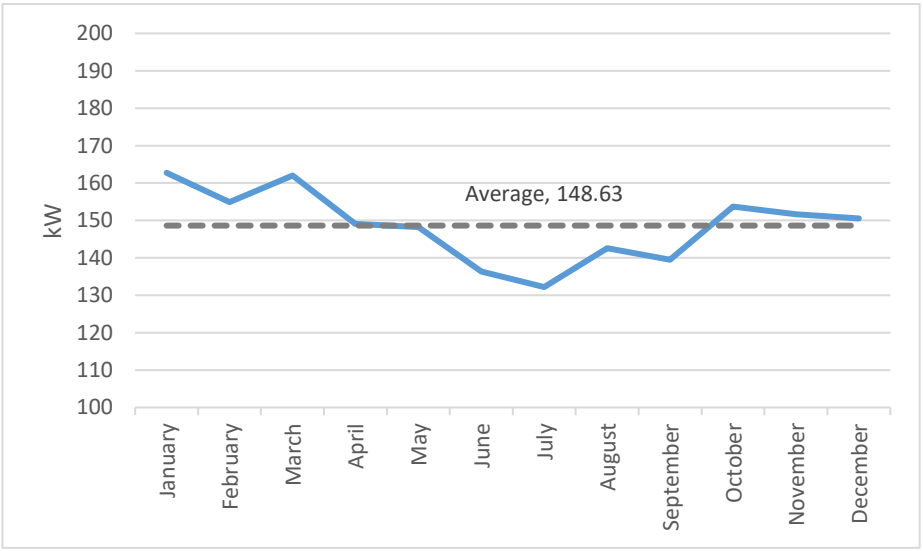

Figure 8: Average daily energy demand per month (2019)

Finally, the community has identified lack of knowledge and skills as a critical vulnerability in their capacity to install and maintain solar PV installations. Currently, there is no electrician living on Masig Island. Based on community testimony, it can take up to several days for the appropriate technician to get to Masig Island, depending on the type of issue. Because of this,

the community feel extremely dependant on outside help and intervention for the maintenance of their energy supply.

3.1.2 Energy Generation

Electricity is supplied by Ergon on behalf of the Queensland State Government. It is sourced from an isolated power station located in the town area by four diesel generator sets (generators), each with a maximum operating power of 100kW which, combined, consume approximately 1,000L of diesel per day. The plant runs 24 hours per day to provide energy to the community. It is reported that the plant is operating at capacity for current population numbers. Upgrades would be required in the event of increased electricity demand related to (increased individual usage, continued population growth, tourism development, etc.).

The airstrip light system, the pilot's house and the health-care centre have backup generators. However, the community and the IBIS shop do not have backup generators.

The lack of energy security was raised as being an important source of stress for the community, especially elders. Power outages can occur one to two times per year for a variety of reasons including branches breaking power lines, fauna damaging the equipment as well as machinery operators damaging the lines. During a power outage, almost all activities on the island are stopped or impacted including payments, communications (except satellite phones), food and medication supply, as well as access to water (mains), cooking (excluding LPG), refrigeration and many other aspects of the community's daily routines. Power outages also impose a financial burden on residents due to loss of food when refrigeration systems stop operating. Heat also becomes a health and safety issue, particularly for elders, as fans and air-conditioners are not working during blackouts.

As power outages are more often caused by power line issues, recent examples being interference from a snake getting stuck in the electrical equipment and a vehicle damaging power lines, power outages will affect specific areas of the island. Based on community testimony, blackouts occur for a matter of hours, sometimes up to two days, depending on the nature of the issue and how long it takes for an Ergon Energy technician to address the issue.

Another notable issue regarding energy safety is if a power outage impacts only part of the island but includes the IBIS shop, no one on the island can top up their power cards. As the IBIS shop is the only place on Masig where cards can be refilled, this effectively cuts out power for these residents who are not technically affected by the blackout but are left without a way to refill their cards, amplifying the impact of the power outage beyond those immediately affected by the blackout.

The community highlighted the need for more widespread back-up power sources such as solar to increase resilience and improve comfort. There is no history of energy brownouts on Masig, based on community discussions.

In terms of residential energy consumption, the average household on Masig Island uses less energy than the Queensland average, as seen below in Figure 9.

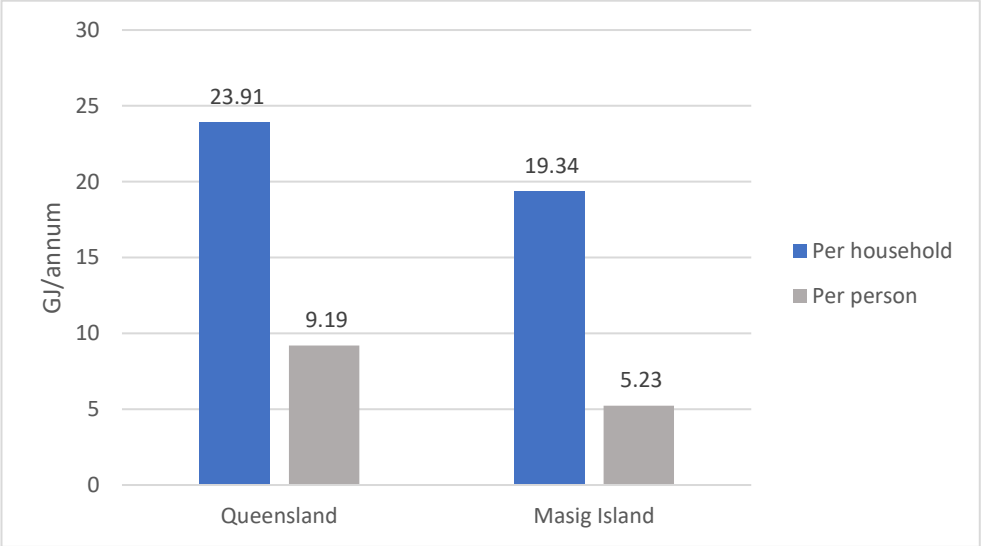

Figure 9: Electricity consumption on Masig Island compared with the Queensland average[10]

3.1.3 Solar Profile

Solar hot water panels can be found on most houses throughout the island. Based on the findings of the final report for the Remote and Isolated Communities Essential Services Project (RICES), it is estimated that approximately 81% of homes have solar hot water systems. Furthermore, approximately 37% of homes have electric booster systems, though only 28% of homes report to having a functional booster system.[13]

Anecdotal evidence suggests that majority of solar hot water systems are 300 litre Solarhart systems. A small number of solar hot water systems are covered with a metal cage for protection. Based on discussion with multiple members of the community, the solar hot water systems provided with homes seem to be sufficient for household demand.

In terms of solar photovoltaic energy production, both the IBIS shop and the desalination plant have solar photovoltaic systems for a combined 10kW, which are exposed to approximately 3,000 hours of sunlight per year, corresponding to 30,000 kWh of energy produced per annum[14].

There are some solar streetlights on Masig Island, notably on the boat ramp near the jetty. During community consultations, residents highlighted the need for more solar lighting around the island to create safer communal spaces and work environments. Community groups are eager to increase the usage of solar PV systems combined with battery storage to decrease energy costs across the community. However, more understanding and upskilling related to solar power and related infrastructure is needed by the community.

[13] (Beal, et al., Exploring community-based water management options for remote Australia., 2019)

[14] *Solar specifications provided by Ergon Energy, current as of 2019.*

3.1.4 Energy Consumption

Residents use a card prepayment system to pay for their power. This card can be charged with credits at the IBIS shop. It has been raised by community members that this system can negatively affect the community by distancing residents from a detailed understanding of their energy consumption profile (when and how they use energy) and how much they spend on energy over time. For example, based on resident testimony, a $20 power card typically lasts a few days and a $50 card lasts about a week (this may highly vary depending on the household occupancy and energy needs). There is a strong understanding of how long a home will be provided with energy, but seemingly limited understanding of how much energy is consumed as well as how it is used. Nevertheless, discussions with the community reveal that residents typically spend $200 per month on Energy cards. ABS data suggests the median weekly household income on Masig is $862, meaning that electricity costs account for approximately 6% of the island's median household income. This percentage can be much higher for lower income households on the island.

Based on community testimony, residents very rarely go without energy supplied to their homes. There are multiple support frameworks for residents to have access to power, including IBIS and TSIRC subsidies providing top ups to the power cards of residents in need. It is not properly understood how often residents on Masig are left without power and for what reasons they may be cut-off from supply.

Energy cards were flagged as being a significant expense for the community, corresponding to a significant proportion of household income, especially for the large portion of the households on the island (40%) earning less than 650$ per week. For this reason, community members are interested in projects which extend the time they get out of a power card, meaning energy efficiency as well as behind the grid solutions.

3.2 Energy Efficiency

The following section provides an overview and background to energy efficiency on Masig Island, including energy efficient practices, and building types and design.

3.2.1 Overview of Energy Efficiency

Energy efficiency has been identified within the community as a critical issue. Energy prices constitute an important part of household and business expenditure and any reduction in energy prices will have a positive impact on the community's quality of life. To-date there has been minimal investment in energy efficient appliances and lighting. A few solar lights have been installed, notably at the jetty, however, a significant amount of work remains to increase awareness and to implement island-wide energy efficient practices and technologies.

3.2.2 Energy Efficiency Practices

There is a high rate of community support for building improvements which can help reduce the interior temperature as well as reduce household energy bills. The community has also expressed

interest in learning more about energy efficiency, especially if this leads to upskilling and potential job creation on the island.

TSRA are currently running a project which aims to develop understanding around climate change and the impact on living conditions. The project monitors the temperature of different interior spaces including council buildings and homes. In some instances, the interior temperature was found to be well over comfortable or healthy levels (including a home with elderly community members).

Currently, there appears to be minimal education surrounding energy efficiency on the island. TSIRC run a small efficient appliances program, where they buy energy and water efficient appliances and sell them back to community for a fixed, relatively low, monthly rate. This allows residents to reduce the economic impact of purchasing new, more efficient appliances at an affordable price while allowing the council to guide residents towards more efficient choices.

3.2.3 Building Types and Design

Housing on the Island (provided and built by the Department of Housing and Public Works (DHPW)) complies with standardised Queensland Government housing codes but does not seem to properly consider the environment in which they are built. Sustainable design concepts such as natural shading, ventilation, window glazing, or insulation are all but absent from the homes on Masig. The roofs of the homes are mostly dark-coloured metal sheeting, which can contribute to higher interior temperatures. Furthermore, windows are typically quite small, reducing natural light and airflow.

Stakeholder feedback suggested that social housing contracts were awarded on lowest cost meaning that while homes may comply with minimum efficiency requirements, they can be poorly suited to the conditions of the Torres Strait. This can result in homes being cramped and getting extremely hot during the summer months. Insufficient insulation in the home ceilings was suggested as a potential issue by members of the community. Furthermore, many homes do not have air conditioning units and the ones that do must deal with the high costs of energy to operate the units. Most non-residential buildings have air-conditioning running throughout the day. Energy prices may be less of a constraint for organisations than for residents, contributing to this difference in usage.

The community found that some of the older homes on the Island to be better adapted to the heat and the conditions of the Torres Strait. This may be due to changing contractors and variations in government regulations over time. More information is needed as to how and why the older homes mentioned during community consultations are sometimes more comfortable. This could be explored in more detail during home audits, as proposed in Project Option 19: Community-led Housing Design.

4 Water Use and Wastewater Treatment

The following sections provide an overview and background on water use and wastewater treatment on Masig island, water infrastructure, water treatment, water consumption, water quality and wastewater management.

4.1 Overview of Water Consumption

Masig Island has mandatory water restrictions that typically operate during several months of the dry season. As a result, residential water consumption is much lower on Masig Island, compared with other Indigenous communities. For a number of reasons identified by Beal et al. (2018), residential water consumption is usually high in Indigenous communities, often being over 700L per day per person and sometimes reaching 1,500L per person per day. In comparison, Masig Islands' residential water consumption is much lower than these numbers, at approximately 296L per person per day, corresponding to 1,058L per household [15]. The fact that Masig Island has strict water restrictions for parts of the year needs to be considered when comparing water consumption numbers, as this significantly alters water consumption habits compared to communities without such restrictions.

Potable water is generated through a reverse osmosis desalination plant combined with collected rainwater from the lagoon. All official homes and buildings on the island (this may exclude camps on the beach) are connected to the mains water supply. During the island visits, it was observed that non treated water is obtained via rainwater collection from individual homes as well as the multiple wells dispersed around the island[16]. It is important to note that some residents choose to drink the rainwater. The water from the wells is brackish and is used for irrigation purposes.

As every litre of potable water produced has an associated emission, any potential gain in water efficiency or decrease in water consumption correlates with an important opportunity to decarbonise the island.

Almost all potable water is produced by two reverse osmosis desalination units located near the airport on Dan street (middle of the island). These units can produce 70kL and 50kL of potable water per day for a combined production of 120kL per day. This water supply is supplemented by the collection of rainwater on the lagoon covers[17]. The water infrastructure on Masig consists of the desalination plant, the water storage lagoons, the elevated tanks as well as the mobile desalination plant (only used in periods of need) as seen in Figure 10.

[15] (Beal, Jackson, Stewart, Rayment, & Miller, Identifying and understanding the drivers of high water consumption, 2018)

[16] (Torres Strait Regional Authority, n.d.)

[17] (Torres Strait Regional Authority, n.d.)

Figure 10: Water infrastructure Masig Island[18]

Both reverse osmosis desalination units typically operate side by side in the same council building. During the Project Team's first visit on Masig (September 2019), one of the desalination units was non-functional due to an electrical fault, requiring technicians to be flown-in for repair works. This highlights the extended timeline of the repair process and the importance of having a backup desalination unit, which Masig does have.

The desalination plant utilises saltwater sourced from a bore near the jetty. The water is desalinated, filtered through a liquid chlorinator and sand filter before being stored in two concrete lagoons (covered by polymer tarps) which can hold several months' worth of potable water. Water quality and levels in the lagoon are closely monitored for quality by TSIRC on a regular basis. Water from the lagoons is pumped into an elevated tank (directly adjacent to the lagoons) before it is distributed for consumption to generate pressure. This pressure is necessary to move water through the system and create flow from the taps across the island. Lagoon water quality and levels are regularly and thoroughly inspected by TSIRC. Masig is one of the few divisions in the area that generally has stable year-round lagoon storage levels.

Non-potable water infrastructure on the island includes freshwater wells and rainwater tanks. There are approximately 33 freshwater wells on the island. According to residents, these were traditionally used for drinking water, but have been progressively abandoned since installation

[18] (Torres Shire Council, 2015)

of the desalination plant and sea level rise, contributing to the brackishness of the water. The TSRA Restoration of Wells project (2019) has renovated 9 wells and installed pumps to provide a source of water for non-potable use such as supporting food gardens to residents who have a well on their land. There is no well-water distribution system beyond this. The water in these wells is relatively poor quality and has varying levels of brackishness, depending on elevation and proximity to the ocean.

Approximately 81% of homes are equipped with a rainwater tank[19]. It is unclear in what condition these tanks are in and how much they are used. It is understood that rainwater is utilised for gardening, cleaning as well as drinking, due to some residents preferring its taste over desalinated water. It was suggested that filters and ultraviolet treatment for the rainwater tanks could be beneficial to rainwater quality, though more information and understanding around this issue is needed. Community testimony revealed that some tanks are not connected for rainwater collection, but are filled with mains water, to ensure water reserves during restriction hours. This is known as "24/7" water supply in the community. Finally, there seems to be significant variety in water tank usage and installation. Some residents have reported needing to go outside to access tank water, while some are connected to a tap in the house. More detailed information is needed around the use of water tanks, infrastructure condition as well as maintenance practices.

4.2 Water Consumption

The production limits of the desalination plant coupled with the higher water demand and water scarcity during hotter months can reduce water reserves, requiring water restrictions to be imposed throughout the Torres Straits. Houses can be cut-off for several hours a day for several months of the year. During water restriction periods, the water supply is cut-off from 9:00am to 12:00pm and from 1:00pm to 5:00pm. Non-residential buildings such as the school, health centre, and the council buildings have a constant water supply[20].

These water restrictions pose a strain on the community, especially for elders and younger children and those who do not have access to "24/7" water supply. It was raised by community members that this also creates stress on people, who must plan their days around water restriction scheduling. As a result, bottled water is heavily relied upon for drinking water which is a financial burden for the community. The increased use of bottled water also creates additional carbon emissions related to transport and waste management.

Due to increased community awareness combined with the use of smart meters throughout the community, the Masig community have not had water restrictions since 2018[20].

As shown in Figure 11, residential water usage is significantly higher than water usage in non-residential buildings. This aligns with typical water usage profiles in Australian remote communities. This can be explained by the average household size in these communities being

[19] (Beal, et al., Exploring community-based water management options for remote Australia., 2019)

[20] Torres Strait Islands Regional Council councillor representative, current as of 2020.

significantly larger than in urban communities, the higher proportion of residential buildings over non-residential buildings[21] as well as lack of industries.

On Masig, non-residential buildings included the council office and community hall, the health centre, the school, both shops, My Pathway building and the Ergon Energy building.

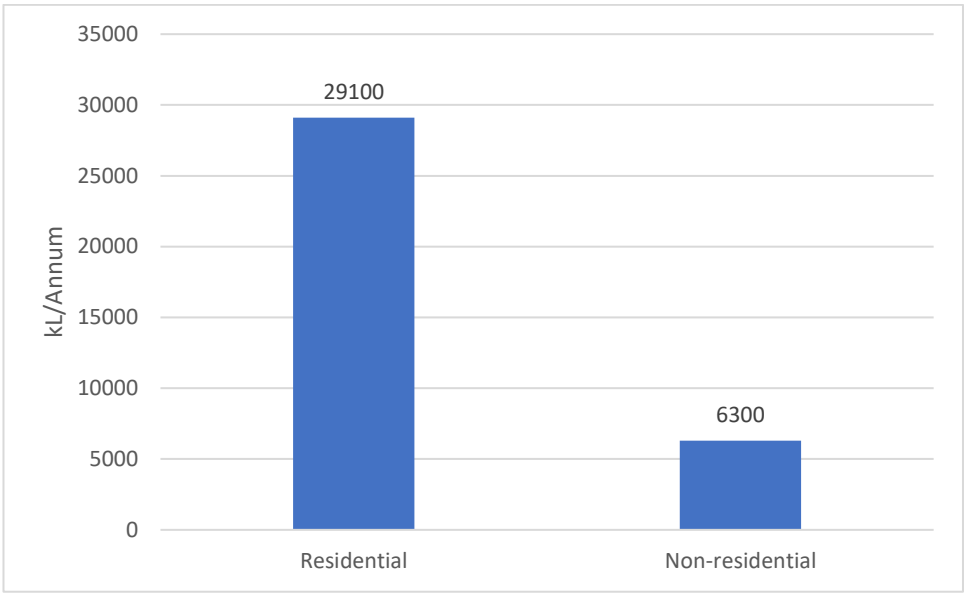

Figure 11: Comparison of water consumption between residents and businesses (2018/19 FY)[22]

Since 2014, Masig Island has been part of the *Remote and Isolated Communities Essential Services* (RICES) Project. This project aimed "to determine how water and water-related power is used in homes in remote communities when the consumer does not pay for water, and develop a more reliable, resilient essential service model in consultation with residents"[23]. Smart water meters including high resolution data loggers were installed in multiple homes on the island so water usage could be measured. Annually, 35.4ML of potable water is supplied to the community.

On an individual household level, based on the RICES smart meters installed in individual homes, 200L per person per day are consumed between June and July (dryer months). Between December and January (wetter months), 184L per person per day were consumed[24]. As illustrated in Figure 12, indoor use makes up the largest proportion of individual water usage followed by outdoor use then leaks. Indoor usage is comprised of tap water, shower/bath, washing machines as well as toilets.

[21] (Beal, Jackson, Stewart, Rayment, & Miller, Identifying and understanding the drivers of high water consumption, 2018)

[22] (Torres Strait Island Regional Council, 2019)

[23] (Rosengreen, 2019)

[24] (Beal, et al., Exploring community-based water management options for remote Australia., 2019)

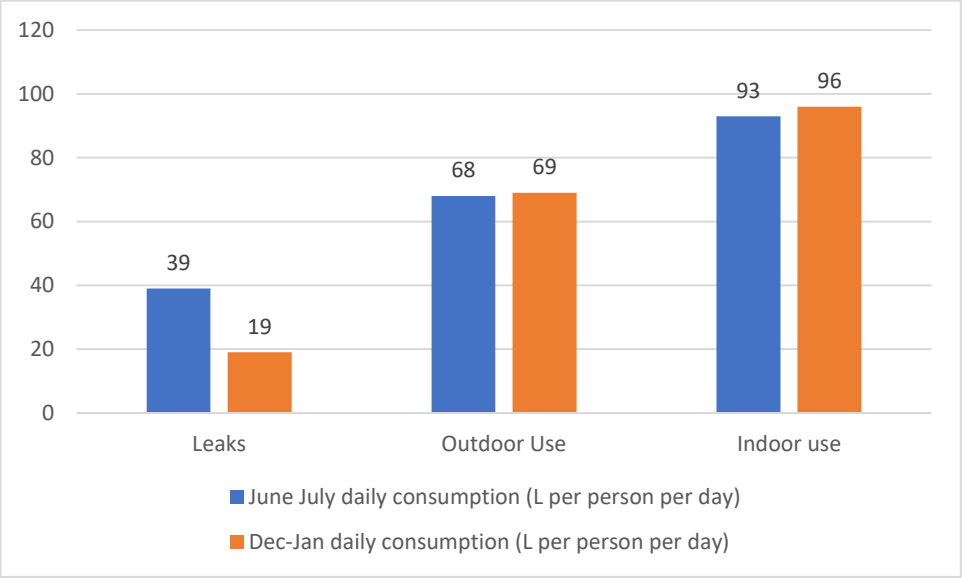

Figure 12: Masig June-July daily consumption for the dry and wet seasons

Based on RICES project findings from data collected between 2015 and 2018, the energy related to water usage was broken down in the following manner (including desalination and hot water). Outdoor water usage and other activities made up 49% of water consumption. In terms of indoor water use activities, 15% was associated with showers/baths, 11% was used at kitchen taps, 7% for washing and 7% for toilets[25].

The RICES project found that with a combination of precise water measurement, water consumption education as well as co-developed community-based water demand management strategies, per person water consumption was reduced by 39% over the project lifespan.

A council-run program also provides access to water efficient white goods and appliances when they need to be replaced. This is administered through a bulk-buying scheme run by council. Members of the community can buy the more efficient white goods from the council with a $100 deposit. This reduces the upfront costs associated with higher efficiency appliances for community and reduces the strain on the water supply for the council.

[25] (Beal, et al., Exploring community-based water management options for remote Australia., 2019)

There are multiple water tanks on the island on both council owned as well as residential buildings. To avoid the impacts of the water restrictions, some community members have two water tanks installed on their property, one for rainwater, the other for mains water. The number of systems is not known by the local authority[26]. The tank hooked to the mains water is filled during non-restriction hours, enabling the residents to have running water during restriction hours. It is unclear how many members of the community do this. This is a contentious issue on the island and seen as unfair by the members of the community who must abide by the water restrictions. More detailed information around this issue is needed in order to fully understand the situation and possible inequities within the community.

As shown in Figure 13, Masig Island households use approximately 297kL of potable water per annum (excludes non-residential water consumption) compared with the Queensland average of 203kL per annum[27]. It is important to consider that homes on Masig house 40% more residents that the state average, which can explain the higher water usage per household.

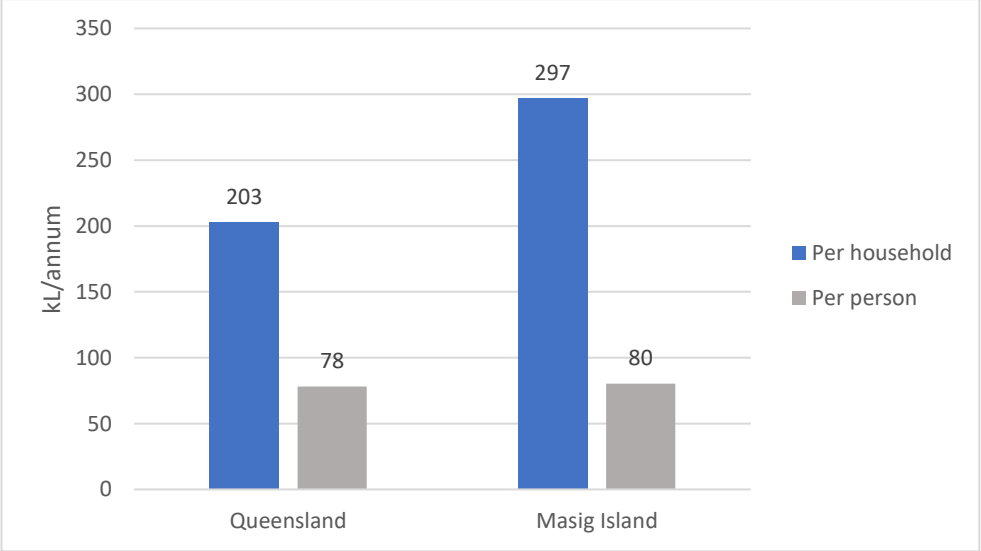

Figure 13: Residential water consumption on Masig Island compared with the Queensland average (2016/17 FY)

4.3 Wastewater Management

All community homes are connected to the island's wastewater treatment site. Family camps on the beachfront are not connected. The plant has a designed capacity of 535 equivalent persons, which correlates to a 120kL/day maximal capacity. Masig Island's population corresponds to

[26] (Beal, Jackson, Stewart, Rayment, & Miller, Identifying and understanding the drivers of high water consumption, 2018)

[27] (Australian Bureau of Statistics, 2019)

approximately half of the plant's capacity, thus it is estimated that 60kL of wastewater is treated daily[28].

Based on discussions with TSIRC, the quantities of sludge produced are not measured by the council. Wastewater is treated at the plant and the liquid sludge is dried in drying beds with a capacity for 4m^3. These beds are de-sludged approximately once per month and the collected dried sludge is disposed of in the designated area at the waste management site. Information around exactly where and how this waste is managed was not provided to the project team.

At current usage, it is estimated that the wastewater treatment plant uses 35,000kWh/year on average[28].

Sewage from the reticulation system is collected in three pump stations and pumped to the wastewater treatment plant. Based on communications with TSIRC, due to the environmental sensitivity of the area, the plant meets a B class discharge quality (minimum license requirement for discharge to the environment) and can be upgraded to A class if required. There is no recycling or re-use of water from the sewage treatment plant. Local workers are employed to assist in plant operations and maintenance.

[28] *Wastewater specifications and data provided by Torres Strait Island Regional Council, current as of 2019.*

5 WASTE AND RECYCLING

The following sections provide an overview and background on waste and recycling on Masig Island, including waste disposal, and re-use and recycling.

5.1 Overview of Waste Management

Waste is an important issue, as it is for most island communities, due to limited space and the high cost associated with management and removal. The waste management site is relatively well organised, clean and managed. It was reported that the site is reaching its capacity (an estimated 5-10 more years before capacity will be reached), which is a source of concern for the community.

Biosecurity restrictions are applied in the Torres Strait region, and include the following goods:

- fresh fruit and vegetables;
- live animals, including insects;
- live plants, including cuttings, seedlings or plant products;
- soil;
- used machinery and equipment with animal, plant material or soil contamination;
- untreated hides or skins or other animal products;
- meat or dairy products (excluding canned items); and
- poultry products, including eggs or feathers with skin still attached.

Any of these goods crossing one of the zone boundaries, as indicated by the red arrows and the black hashed zone boundaries in Figure 14, requires a permit and compliance with regulations. As general waste is included in these categories, waste transportation between islands or to the mainland (moving south) is complicated and expensive. Essentially, it is the southward flow of materials which is regulated and requires specific permit.[29]

[29] (Australian Government Department of Agriculture, Water and the Environment, 2020)

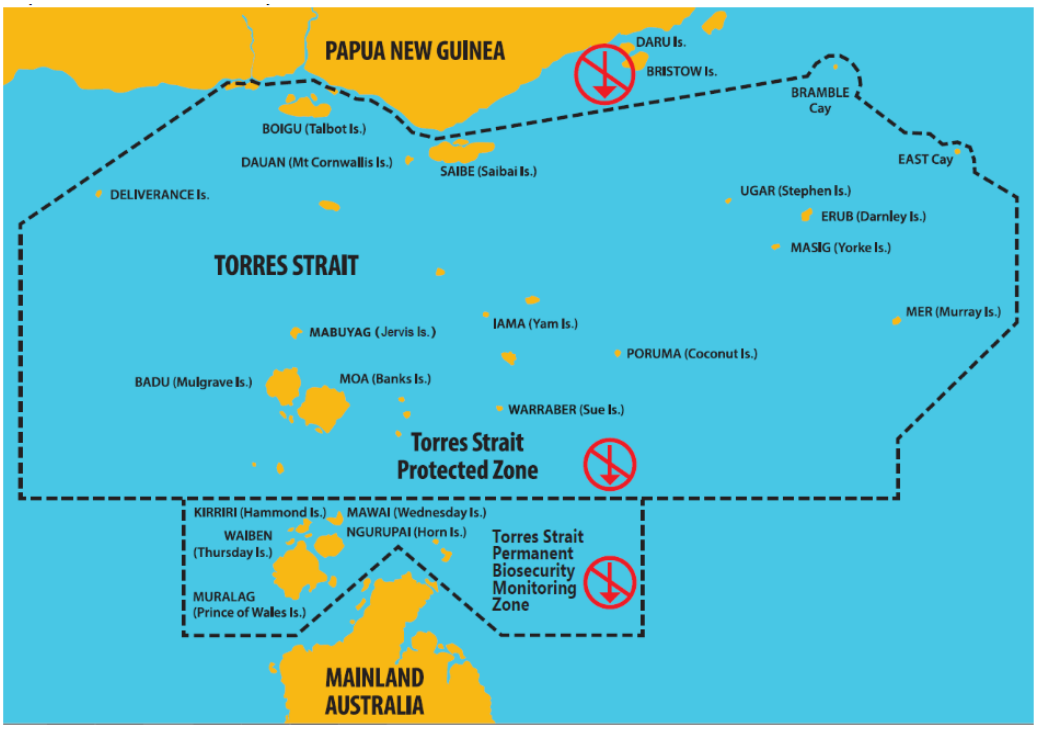

Figure 14: Map of the Torres Strait biosecurity zones

The community also faces challenges in removing the vehicle waste on the island, due to the high cost of disposal of this type of waste. It reportedly costs between $10,000 and $11,000 to remove a single car body. Because of this, old car bodies are strewn across the island and left to degrade (see Figure 15).

Figure 15: Car bodies on Masig Island

The exact number of car bodies strewn across Masig is not known, but it is estimated by community members that most houses have at least 1 old car body. This would equate to approximately 90 old car bodies across the island. These pose a significant challenge for the

community, as they pose environmental risks as they degrade and occupy precious space on such a small island. To counter this, a "one on, one off" policy was discussed, but it seems to still only be an idea. This initiative would involve the removal of an old car body for every new vehicle brought onto the island. Old boat hulls are also accumulating on the island, the number of these is not known (see Figure 16).

Figure 16: Disused boat hull on Masig Island

5.2 Waste Disposal

Waste is collected twice a week by TSIRC using a small-sized garbage collection truck (see Figure 17). Three waste streams are collected: household general waste (which also includes recyclable items and kitchen scraps), green waste and other bulky items such as white goods and scrap metal. All waste is brought to the island's landfill site.

Figure 17: Waste collection truck on Masig Island

Once at the landfill, the general waste is disposed of in large trenches to be buried. The waste trucks dispose the general waste directly into the designated pit. Some of the waste was observed as being charred and occasionally emitting smoke. This may be due to occasional fires affecting the landfill site. The community is aware of the fumes potentially being harmful for their health. The community is also concerned about the lifespan of the landfill site, as space is rapidly running out for new landfill trenches. TSIRC continue to work with DES towards sustainable long-term solutions around waste management, recognising the unique challenges of island footprints and biosecurity restrictions around waste movement.

White goods are stored at the waste management site (see Figure 18). More information is needed around the specific treatment process of the white goods to collect refrigeration gases or valuable metals. Various forms of metal waste currently accumulate at the waste management site. The community have raised concerns of this waste pile becoming overgrown with vegetation, creating a fire hazard. This has reportedly happened in the past, leading to challenges in eventual removal from the island.

Figure 18: White goods and large waste items on Masig Island

Green waste is collected and disposed of via landfill at the waste management site. Previously, residents were permitted to burn their own green waste at their homes. Based on conversations, this helped reduce the number of mosquitoes on people's properties as well as continue the cultural practice of burning and caring for country. This practice is no longer permitted by state government due to the associated environmental risks, including Great Barrier Reef (GBR) considerations. All green waste, including branches, leaves, coconuts, etc. is collected by TSIRC and disposed of at the landfill site. Aside from a few residents composting at their homes, there is no composting on a larger scale.

There is a mulching machine that is owned by TSIRC that is not accessible by the community to make mulch and to compost trees and branches. It has been reported by TSIRC that this machine is not currently operational and that it is an industrial-sized machine that is not appropriate for

individual use. A stakeholder at TSIRC raised that providing mulching services is not within council scope and budget, but there is a willingness to explore more composting options.

Waste on Masig is composed of mainly residential waste (74%), followed by green waste (14%), construction and demolition waster (12%) and a small proportion of commercial and industrial waste (0.6%) (see Figure 19)[4].

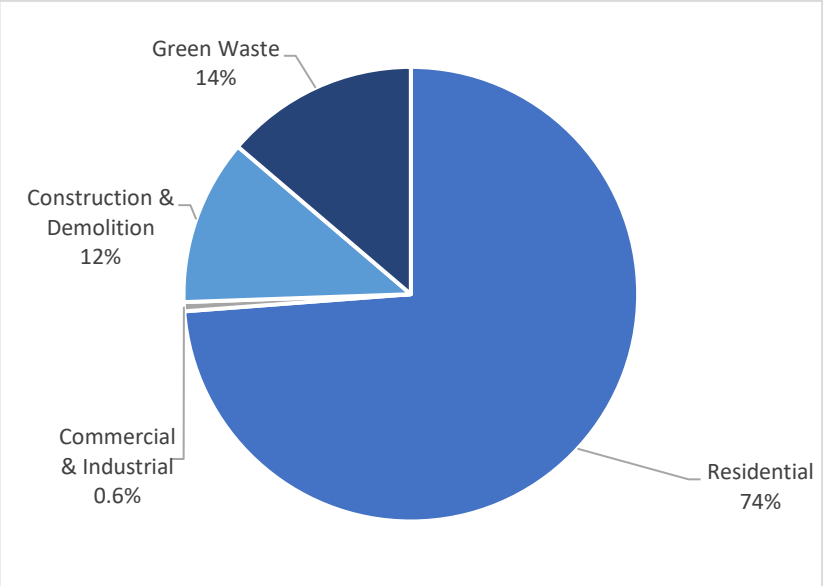

Figure 19: Waste disposed to landfill profile (2019)

As shown in Figure 20, Masig Island produces less per capita residential waste annually than the Queensland average[30]. The difference in waste per capita production between Masig and Queensland aligns with the existing correlation between community socioeconomic profile and their waste production, where lower socioeconomic communities typically produce less waste than higher socioeconomic regions. This difference is also exacerbated by the remoteness of the community, likely making the supply of goods more expensive and less accessible, resulting in less materials sent to landfill.

[30] (Queensland Government, 2020)

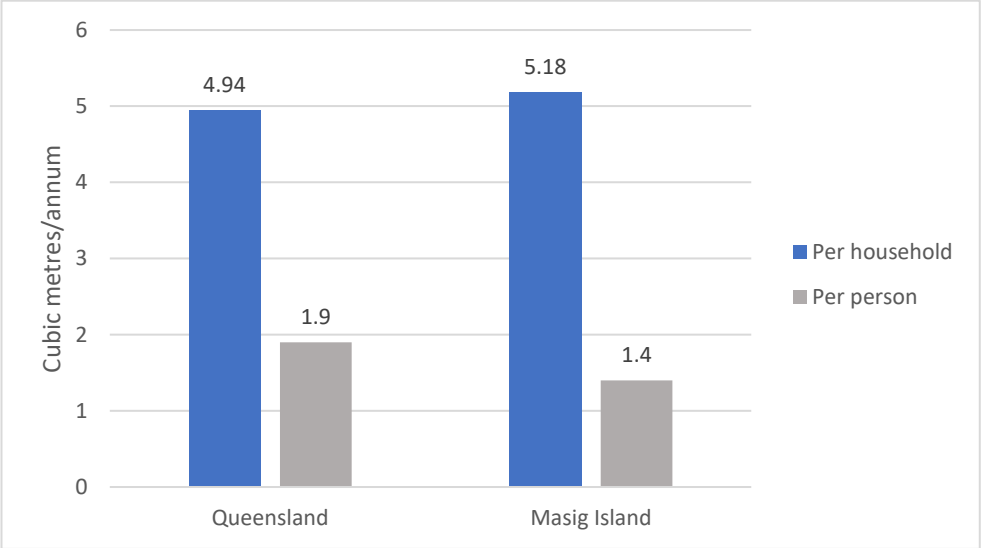

Figure 20: Waste disposed on Masig Island compared with the Queensland average (2016/17 FY)

5.3 Reduction, Re-use and Recycling

Though there is no council-operated recycling initiative, there are many ways in which the community reduce, re-use and recycle materials and resources.

The school has implemented a container collection program in collaboration with SeaSwift, providing a small income stream to the school. SeaSwift collect the containers from the designated collection points (clearly identified frames and container bags) on an as-needed basis. The returns of this program are not known, but it is estimated by SeaSwift that each bag can generate between $75 and $220, depending on the containers. However, SeaSwift raised that the participation in this program is relatively low. Community knowledge of this program was limited. There is high potential for such an initiative as a similar program on Coconut Island raised $1,000 over two terms. SeaSwift has expressed willingness to transport other recycling off the island. This has not yet occurred as recycling is not properly sorted on Masig Island (understandable as there is no recycling on the island). Furthermore, a transport agreement between SeaSwift and TSIRC has not been reached.

The My Pathway group collects wooden pallets left behind by the barge at the jetty. These are used to make all types of furniture for the community including beds, tables, benches and seats. Currently, My Pathway are also storing old unused pipes which could be used for future projects such as a hydroponic/aquaponic system, vegetable garden and more furniture/equipment.

The community on Masig also re-uses materials for crayfish crates (see Figure 21). These are made up from a variety of materials including pallets, buckets, old nets and buoys. These crates are kept afloat off the jetty and are filled with crayfish awaiting to be sold. The project team observed around a dozen such crates near the jetty area during the site visits.

Figure 21: Crayfish crates made from recycled materials

Finally, there is a motivation on the island to change waste management practices. For example, the school wishes to set up a worm farm for composting with the aim to sell the output to the community as well as council for use in gardens. TSRA have purchased and brought a biogas digester to the island as a pilot project, but it has not yet been installed due to complications around location, maintenance and waste collection systems. It was raised by a member of the community that although many residents are enthusiastic about the idea of changes and new projects, they prefer to see things in action before they choose to implement them in their own households.

6 TRANSPORTATION

The following sections provide an overview and background on transportation on Masig Island, including on-island transport, public transport, marine transport and barges, and air travel.

6.1 Overview of Transportation

Transportation is quite restricted due to the island's small area. Residents get around the island and travel to work mainly by walking, and by car (including ridesharing), as presented in Figure 22[31]. Cycling is also prevalent on the island, though has not been captured in the ABS census data used for the figure below. Transport is an expensive endeavour on Masig due to its remoteness. Transport to and from the island is expensive, but on island transport by motorised means is also expensive due to the high costs of fuel, which is barged over from the mainland.

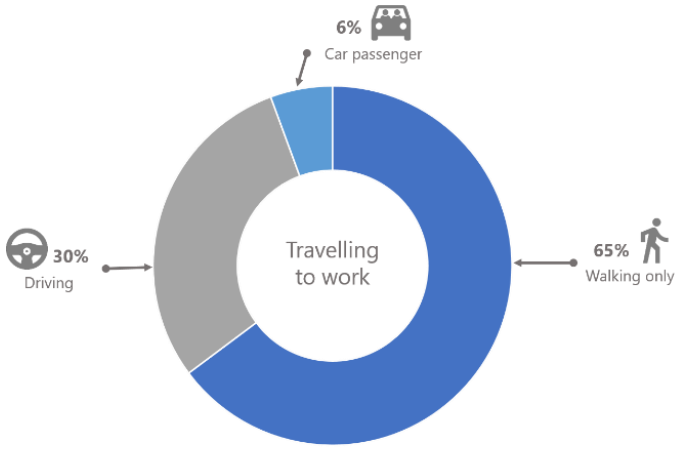

Figure 22: Transport method employed to get to work (2016)

Masig Island can only be accessed by air transport, though Islanders also move between islands on their dinghies, but distances travelled and frequency are unknown. Passenger transportation to and from the island occurs by small single propeller planes. SkyTrans operates flights two to three times a day to Masig Island, except on Sundays and public holidays. Torres Air and Cape Air also provide charter flights in the Torres Strait region.

All supplies are barged from the mainland. Transport services, including air travel and the barge, are provided to Masig as a loop including other islands. The Skytrans loop includes Darnley and Murray Islands, whereas the barge loop includes Stephens, Darnley and Murray Islands. These loops were considered as intrinsic to the existing transport service and were included in Masig's transport profile in its totality, contributing to the high proportion of energy usage associated with the air transport and marine transport categories. Figure 23 illustrates the breakdown of energy associated with each of Masig Island's transportation modes.

[31] (Australian Bureau of Statistics, 2019)

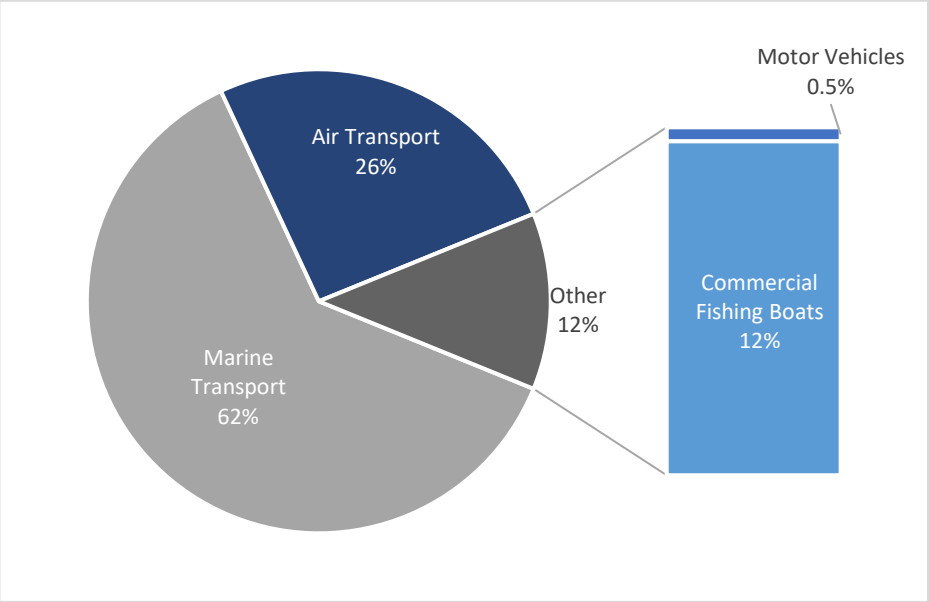

Figure 23: Transport fuel usage profile[32]

6.2 On-island Transport

The main mode of transportation on Masig Island is walking. Due to the island's small size, residents can mostly access the whole island by foot and bicycle. Of course, this is not the case for the elderly and other mobility-impaired members of the community. Another mode of active transport which is prevalent on Masig is cycling. There are multiple bikes on the island, and these are used by a wide range of community members, from youth to the elderly. These bikes are purchased through IBIS. They are generally relatively low-cost bicycles and it is not known what their lifespan is for the Masig conditions.

There are approximately 40 road vehicles in use on Masig Island (owned by council, organisations and residents), corresponding to an average of 0.6 vehicles per dwelling, as presented in Figure 24[33]. The ABS reports that 62.5% of households do not own a vehicle. [34] The number of functioning cars owned outrightly by the community is not known.

[32] *An average year for the transport profile is based on a combination of transport modes (air, land and sea) calculated using different assumptions depending on the data and sources that were available at the time of writing this report. See footnotes on the following pages for more details.*

[33] (Australian Bureau of Statistics, 2019)

[34] (Australian Bureau of Statistics, 2019)

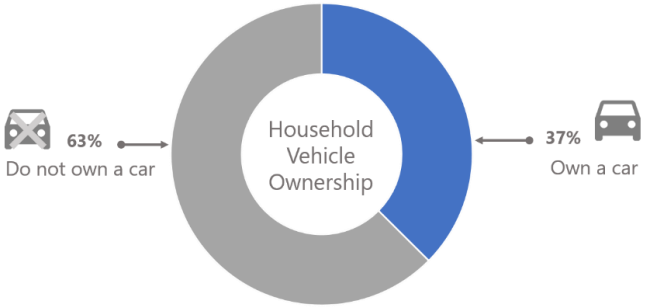

Figure 24: Masig Island household vehicle ownership (2017)

Vehicles are not used for long distances, due to the island's size, but are used on a variety of surfaces such as tarmac and sand tracks around the island. It is informed by the split between fuel types is approximately 53% petrol and 47% diesel[35]. Furthermore, based on a 2018 study on motor vehicles in Australia, average petrol vehicles consume 10.8L/100km of petrol and that average diesel vehicles consume 18.5 L/100km[36]. These figures were the average across all vehicle types including passenger vehicles, motorcycles, light commercial vehicles, rigid trucks, articulated trucks, non-freight carrying trucks and buses. The total annual fuel consumption for both petrol and diesel are presented in Figure 25.

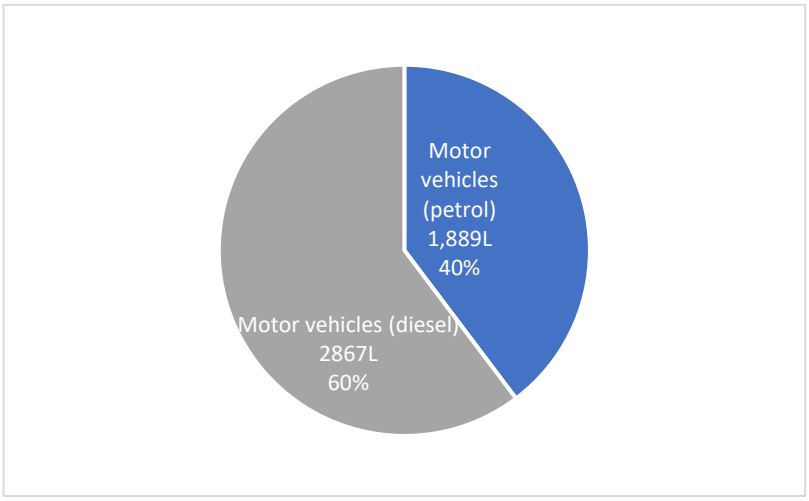

Figure 25: Fuel consumption (L) related to on-island transportation based on an average year[37]

[35] (Australian Bureau of Statistics, 2018)

[36] (Budget Direct, 2018)

[37] *An average year for motor vehicles is calculated based on a combination of assumptions dependent on the data and sources that were available at the time of writing this report. Assumptions based around the number of registered cars, distances to and from key points, and average fuel proportions.*

A key issue for members of the Masig community relying on vehicles is the extremely high cost of getting them on and off the island. Based on anecdotal evidence from the community, it costs between $3,000 and $5,000 to get a vehicle to Masig Island and from $10,000 to $11,000 to get if off the island. These high costs are mainly due to transport, but for old car bodies, biosecurity obligations significantly increase removal cost.

During the sustainability assessment, petrol was sold at around $2.30/L, but it was reported that prices had previously reached $2.90/L. Unleaded fuel and diesel are sold by IBIS. As a point of comparison, unleaded petrol costs approximately $1.20/L in South East Queensland[38].

6.3 Public Transport

There is no public transportation on Masig Island. During the island visits, it was observed that many community members regularly ride-share using their vehicles.

It was mentioned that there was a council shuttle before the formation of TSIRC but no further information was available to provide detail. During community consultations, some residents raised the need for public transport, especially for the less mobile members of the community.

6.4 Marine Transport and Barges

There are 22 commercial fishing boats registered to Masig Island[39]. Most of these are small fishing vessels or dinghies with a few larger fishing boats, the pilot's boat and rescue boats. Most of these boats have outboard motors of approximately 75 horsepower, based on project team observations during site visits. Based on project team observations, there are likely personal dinghies (unregistered) in addition to commercial boats, though the exact number of vessels is not known.

All goods and materials are shipped by barge. SeaSwift is the sole barge operator in the region servicing Masig Island. Recently acquired by the Queensland Investment Corporation (QIC), SeaSwift is increasingly working with local councils to improve the reliability of their service. SeaSwift delivers goods to Masig Island twice a week, typically on Wednesdays and Thursdays[40]. Based on conversations with a company representative, SeaSwift charges $0.53/kg for goods transported to and from Masig Island to mainland Australia (compared to $7/kg for air transportation). SeaSwift also barge all fuel to the island, this includes unleaded fuel as well as diesel. This includes the diesel for the Ergon Energy generators.

Community members also travel around the Torres Strait by boat. There is no commercial passenger service, but residents travel to other islands on their boats and dinghies. During the second island visit in December 2019, there was a wedding on another nearby island, and dozens

[38] (FuelPrice Australia, 2020)

[39] *Register of boating licenses provided by Australian Fisheries Management Authority (AFMA), current as of 2019.*

[40] (SeaSwift, n.d.)

of dinghies carrying several people each were used to travel there. Other anecdotal evidence suggests Masig Islanders travel to Thursday Island to pick up supplies and other necessities. Such trips are most probably a regular occurrence, though the frequency of these trips as well as how many people travel in this way is not known.

6.5 Air Travel

Small single propeller or propeller planes are used for transporting people on and off the island. Skytrans operates flights two to three times a day to Masig Island, except on Sundays and public holidays. Skytrans owns a fleet of Cessna 208B – Grand Caravans, which can seat up to 14 passengers, depending on the weight. Skytrans operates flights from Horn Island two to three times a day to Masig Island, except on Sundays and public holidays. There are no direct scheduled flights from the mainland. These trips are not direct to Masig Island, though they are part of a loop including Darnley Island and Murray Island. This route involves 2.5 hours of flight time, with total loop duration being well over 3 hours.

Horn Island Air and Torres Strait Air operate charter flights in the Torres Strait area and regularly visit Masig Island. Charter flights are commonly used by government agencies, contractors and other organisations visiting the island for convenience and flexibility as this option provides the most direct and time efficient transport mode to Masig (45-minute flight). Accurate numbers around the frequency and the precise routes of charter flights were not available, due to routes changing depending on customer needs and the highly variable nature of the charter flight industry. It was estimated by the charter flight operators that Masig Island was visited approximately three times per week.

The community raised concern about the increased uptake of charter flights as this causes an increase in base prices for the SkyTrans service. Although Torres Strait Islanders benefit from a Local Airfare Scheme (reducing a return flight price by $400), mobility is an increasingly expensive commodity for Masig Islanders, as they are one of the furthest communities from the mainland.

There is a space dedicated to helicopters on the airstrip. This area is not paved or cemented, resulting in a broken and uneven surface (see Figure 26). A small amount of helicopter fuel is kept on the island at the airstrip (multiple pallet-sized tanks) which is mostly used by the Australian Defence Force (ADF) as well as helicopter charter companies. It is not known how much fuel is stored on the Island or how often helicopters visit the island.

Figure 26: Fuel reserves and helicopter landing area on Masig Island

Except for the helicopters, all aircrafts refuel at Horn Island, which acts as the main hub for aviation in the Torres Strait region.

7 RESILIENCE AND SELF-SUFFICIENCY

The following sections provide a background and assessment of the resilience and self-sufficiency of Masig Island. Given Masig Islanders are acutely aware of the current impacts on climate change on their island, this report addresses resilience through that lens. Critically, this involves rise in sea levels, increased severe weather events as well as rapid and drastic changes to the ecosystem.

Aboriginal and Torres Strait Island communities have been studying and observing the natural environment for millennia and have developed a deep understanding around their land and seas. These rapid changes pose an increasing challenge for these communities to meaningfully forecast likely changes or interpret them in a timely way and highlight how rapidly the earth's system is being impacted by climate change. The knowledge held by First Nations communities and knowledge holders will continue to be integral to navigating a path ahead.

Self-sufficiency, the community's proven capacity to provide for itself and adapt to external changes based on millennia of occupying land and sea, is also a key consideration in discussing the Masig Islanders resilience. This involves reserves and access to food and water, telecommunications and energy. This section includes resilience and climate change on Masig, experienced events, climate change projections, community preparedness and self-sufficiency, and disaster planning and evacuation arrangements.

7.1 Overview of Resilience

The concept of resilience is not new to the Masig community. The people of the Torres Strait have been living and navigating the seas throughout the Torres Straits for millennia. Their way of life, culture and traditions are intimately tied with occupying and caring for their land and seas. In this way, the accumulation of traditional and cultural knowledge has enabled the Masigaligal to adapt and live in harmony with their unique and often challenging environment. Cultural and traditional knowledge, developed through millennia of occupying and fostering the region's land and sea, is finding that changes to the environment and the climate are occurring at an increasingly rapid pace and have a profound impact on the flora, fauna and the communities that depend on them.

Cultural and traditional knowledge is still very prevalent throughout the Masig community today. Community elders, Masigalgal Rangers and the Masigalgal RNTBC (PBC) have developed a seasons calendar which explains the different seasons, patterns, winds, tides, rains and food sources. Initiatives such as the seasons calendar are capturing and sharing of thousands of years of knowledge which has underpinned self-sufficiency on the island in the past, and now into the future.[41]

[41] (Bureau of Meteorology, 2018)

The capacity to read the climate and understand patterns from a range of bioindicators underlines the community's self-sufficiency capabilities. The Masig seasonal calendar defines four main seasons for the island. Masig's Kuki (wet and stormy) season occurs from December to April with rainfall reaching 1750mm during some events. Woerr/Sagerr (windy season) spans from March to September and is characterised by a south-easterly wind. Naigai (hot and dry) follows with calm winds from September to November. During this dry season the region receives only about 90mm. Finally, Zei (windy season), from November to January is characterised by south–westerly winds (see Figure 27).

Figure 27: Project team members with the Masig seasonal calendar

Although this cultural and traditional knowledge still runs deep in the community, it has been raised in multiple community discussions that pressures are being exerted on the environment resulting in changes in climate. These climatic changes have, in turn, altered the patterns and seasons understood in cultural and traditional knowledge. Seasonal winds, rains and flora/fauna seasons are no longer what they used to be, disrupting the synchronicity of environmental interactions. Environmental signals are moving through an environmental breakdown, causing systemic changes throughout ecosystems.

On Masig Island, community resilience for Masig is also closely tied to energy security, water reserves and fuel supply. The island is almost completely dependent on energy for its fresh water supply due to the reliance on a desalination plant, as discussed in the water section of this sustainability assessment.

Finally, the Masig community's main concerns relating to resilience are the climate change induced sea level rise related to global warming. Being a coral cay only three meters above sea level, Masig Island, as well as many other islands in the region, is critically vulnerable to the impacts of rising waters. Over the last 40 years, rising sea levels combined with intensified storms and severe weather events have caused increased island erosion and the loss of land. This not only impacts island infrastructure but inflicts huge stress on the community by taking out

traditional land, cemeteries and culturally important landmarks. The Torres Strait Islander culture is intimately tied to the connection with the islands.

A community member from Masig Island articulated well the intimate connection that Islanders have with their land and sea when he stated:

"I am Masig, and Masig is me. If Masig bleeds, I bleed."

To drive change about how climate change is managed in the Torres Strait, a Torres Strait Islander group, including representatives from Masig, sought to set a global precedent human rights violation complaint against the Australian Government, arguing that the government is failing to take adequate steps to reduce carbon emissions. At the time of publishing this report, the complaint is currently under investigation by the United Nations

7.2 Resilience and Climate Change on Masig

For thousands of years, the Masigalgal people have been growing and applying their scientific expertise on Masig Island. As indicated above, the community on Masig has been well-aware of the impacts of climate change and has been discussing and working at the political level for over 40 years due to being on the frontline of the impacts of climate change. More recently, they have used their scientific expertise and understanding to try and educate decision makers and show why something needs to be done to urgently address climate change.

The National Environmental Research Program initiative published a technical report in 2013 titled: *Masig Yesterday, Today and Tomorrow: Community Future Scenarios and Adaptation Strategies*. This community consultation-based initiative discussed resilience and adaptation strategies with the Masig community to rate their perceived resilience[42]. Table 8 below summarises these findings, noting a moderate level of resilience against most indicators except for 'financial capacity', which was identified as medium to low. This resilience indicator highlights the community's high dependency on government funded projects and initiatives. Furthermore, the majority of community members have no insurance due to affordability or lack of understanding around the subject.

[42] (Butler, et al., 2013)

Table 8: Masig Island's perceived resilience (2013)

Resilience indicator	Score (High, Medium, Low, and score out of 5)	Why?
1. Disaster preparedness	Medium-High (4)	1958 tsunami warning – community was prepared with dinghies. Well-prepared, but not highly. TSIRC has Disaster Management Group. SES plan from late 1990s, and SES crews won award, plus rangers skilled up now. Masig Disaster Management Management Plan nearly finished. Still room for improvement
2. Financial capacity	Medium-Low (2)	Government dependence, but there is some coordination. Most people don't have insurance and haven't thought about it.
3. Food and water self-sufficiency	Medium-High (4)	Good supply of marine food and groundwater. But garden food supply could be improved.
4. Work well together to address challenges	Medium (3)	Some areas strong (dealing with food, natural disasters), but could be improved on social, family and cultural areas. Also issues with drugs, alcohol and disengagement between generations.
5. Innovation and creativity	Medium (3)	Sponge farm and potential for a lot more aquaculture innovation. But the right environment for nurturing ideas does not exist.
6. Good leadership	Medium-High (4)	Good representation of all organisations (PBC, rangers, TSIRC, Church) and Elders for government, spiritual and cultural issues
7. Ability of community to organise and make decisions quickly	Medium-High (4)	Work together well on cultural issues. Room for improvement on coordination between Justice Group, Fishermen's Association, Kailag Enterprise, Rangers, Community Enterprise Association, PBC, TSIRC
8. Ability to learn	Medium (3)	Encouragement, more communication needed, plus better governance (e.g. on housing)
9. Networks and partnerships beyond Masig	Medium-High (4)	Mobile network is still not perfect. Good partners and family network off the island. Most people have links to Cairns, Thursday Island and other stakeholders there.
10. Language and culture	Medium (3)	Language is important but today not many people speak it (other than singing)

The QCoast2100 program aims to help coastal communities prepare for the impacts of coastal hazards and develop Coastal Hazard Adaptation Strategies (CHAS). This program looks at the following key points:

- Land use planning and development assessment;
- Infrastructure planning and management including roads, stormwater and foreshores;
- Asset management and planning including nature conservation, recreation, cultural heritage values and other public amenities;
- Community planning; and

- Emergency management[43].

TSIRC is participating in QCoast2100, a Queensland Government funded initiative that is run in partnership with LGAQ to support coastal councils to develop coastal hazard adaptation strategies. These strategies help identify coastal hazards and help plan for defence, adaptation, or retreat. Under this program TSIRC obtain certified engineering plans including surveys and geotechnical assessments of the areas at risk on Masig Island.[44] This will inform further cost assessments for works to protect and defend these areas at risk. Indicative costings suggest it will be several million dollars.

Furthermore, in December 2019, TSRA obtained over $20 million to develop costal defence strategies. These funds will be divided between multiple islands in the Torres Straits, but will include Masig. Based on discussions with TSRA stakeholders, this funding will contribute to the development and construction of rock walls and sea walls at specific high-risk zones around the Torres Strait, including Masig Island. The jetty will also be assessed for upgrade, due to the current design hindering sand movement around the island.

7.3 Experienced Events

Due to its northerly latitude, the Torres Strait region is less likely to be impacted by tropical cyclones, as is the case further south. Nevertheless, there have been several significant cyclone events which are summarised in Table 9[45].

[43] (QCoast, n.d.)

[44] (Torres Strait Island Regional Council, 2018)

[45] (Torres Strait Local Disaster Management Group, 2016)

Table 9: Experienced events in the Torres Strait (2016)

11 Feb 1970	TC 'Dawn' crossed the coast near Weipa. Islands reported gusts of 52 knots. There was minor vegetation damage and telephone lines were down.
25-26 Dec 1959	TC crossed the Gulf from Gove to Edward River Mission. At 9am 26th Thursday Island recorded wind gusts to 69 knots and 63 knots at 3pm. At Thursday Island fences were flattened, trees uprooted and 3 luggers crashed into a jetty.
10-12 Jan 1955	Tropical cyclone near Stationary Gulf Coast just to the north of Weipa. Heavy rain and gales. Islands recorded a gust of 56 knots on the 11th and a gust of 48 knots on 12th.
15-17 Apr 1953	TC tracked from Torres Strait to the North Coast of NT where it caused damage to gardens, crops and woodlands at Goulburn Island.
1-2 Dec 1952	Small TC (50miles wide) struck Thursday Island from the west just before midnight (1st) damaging most buildings with roofing iron flying through the town. Power lines were blown down and four hotels were partly unroofed and two had verandas blown away. The pearling lugger Naianga was smashed and sunk and three other luggers were blown ashore. Several other vessels were damaged by the pounding they received.
20 Jan 1952	TC made landfall near Weipa and then turned and passed over Normanton. Islands had wind gusts to 70 knots on 19th and 20th.
6 Jan 1948	TC moved eastwards towards Thursday Island causing structural damage there. Possible devastating storm surge Saibai Island.
5-8 Jan 1930	TC crossed southern Gulf from Karumba to Pellew Group. Two luggers wrecked at Thursday Island. Strong winds and heavy rain at Roper River and strong winds at Groote Eylandt (from Big blow up North K. Murphy).
Mar 1923	The eastern islands of Torres Strait (usually cyclone free) were badly damaged. Darnley, Coconut, Mabuiag and Murray Islands suffered much damage - houses unroofed, trees down, gardens damaged, luggers distasted and Darnley settlement was virtually destroyed and banks of living coral 4 to 5 feet high were dashed up by the waves .
18-20 Dec 1920	TC tracked from Torres Strait to north of Gove.
1-2 Jan 1914	TC crossed the coast near Gove. Damage occurred at Thursday Island in late December and severe damage occurred at Roper River on 2 Jan with trees blown down and buildings unroofed at the Mission

7.4 Climate Change Projections

The Torres Strait region is highly vulnerable to the effects of climate change. Projected climate change risks include increased temperatures, increased average annual rainfall, increases in sea level, increases in the wind speed of tropical cyclones and a decrease in ocean acidification[46]. The numbers below show climate change projections for the Torres Strait Region for 2050 (data derived from the Queensland Future Climates Dashboard using scenario representative concentration pathways (RCP) 8.5) and are based on long-term regional changes over the reference period of 1986-2005[47] (current as of 2019).

7.4.1 Hot days

The projections from the Queensland Future Climates Dashboard indicate an increase in mean temperature by 0.67°C by 2030 and 1.22°C by 2050, as well as an increase in the number of hot days by 0.43 day per annum by 2030 and 6.51 days per annum by 2050 (see Figure 28).

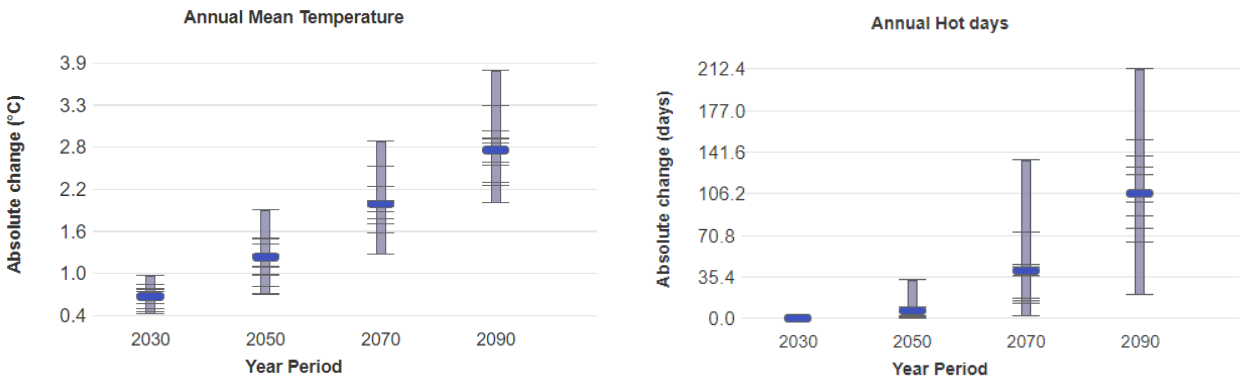

Figure 28: Projected changes in annual mean temperatures and annual hot days for the Torres Strait Island Regional Local government area

As high interior temperatures are already an issue on Masig (exacerbated during power blackouts), the projected increase in temperatures and number of hot days poses a significant risk for the community's health and well-being.

7.4.2 Heatwaves

As shown in Figure 29, heatwaves are projected to occur 30.68% more frequently by 2030, 104.88% more frequently by 2050 and last for longer periods of time. By 2030, it is projected that heatwaves will last 9.72 days longer in 2030 and 35.37 days longer in 2050. This reflects an increase of 33% in the duration compared to the benchmark period in 2050. Hotter and longer heatwaves significantly impact the Masig community, which is already currently dealing with high interior heat levels.

[46] (Torres Strait Regional Authority)

[47] (Queensland Government, 2018)

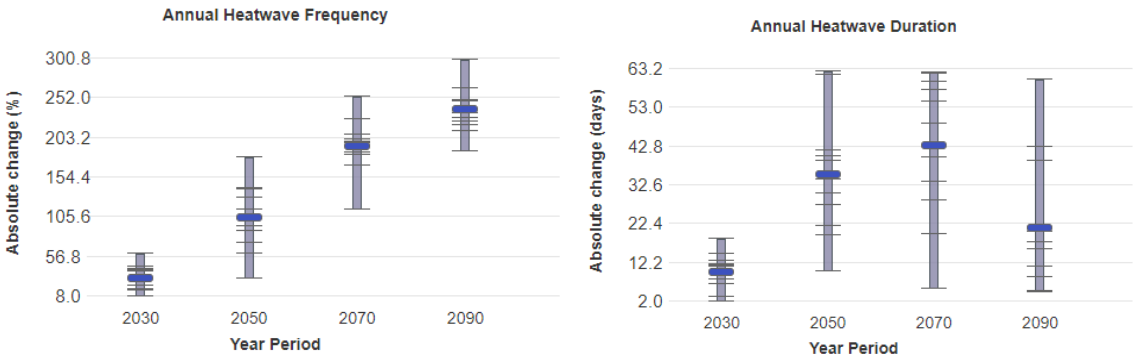

Figure 29: Projected changes in frequency and duration of heatwaves for the Torres Strait Island local government area

7.4.3 Precipitation

As shown in Figure 30, precipitation patterns are projected to change in the Torres Strait region with less annual precipitations on average, particularly during the traditional wet season.

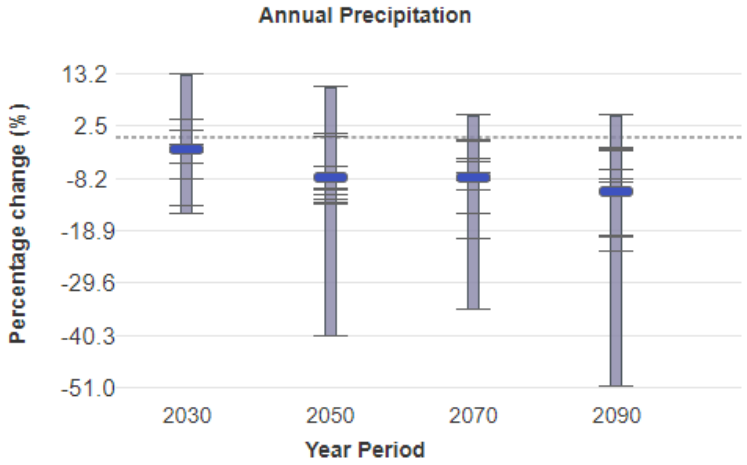

Figure 30: Projected changes in annual precipitation for the Torres Strait Island Regional local government area

7.4.4 Floods

In line with the annual precipitation decrease, the frequency and duration of floods (caused by rainfall) is projected to moderately decrease by 2050, as illustrated in Figure 31. These projections do not include the effects of king tides and storm surges on flood events. The drought events are also projected to decrease moderately both in frequency and duration. This will put a strain on water supply levels.

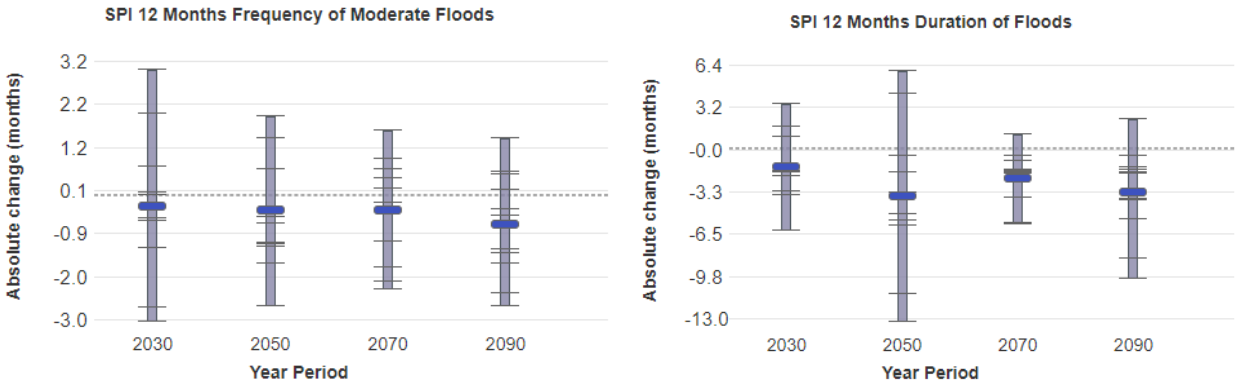

Figure 31: Projected frequency and duration of floods for the Torres Strait Island Regional local government area

7.4.5 Resilience of Island Infrastructure

Most houses on Masig Island are social housing homes provided to the community by the DHPW. According to Ergon Energy, there are 89 residential buildings on Masig as well as 26 non-residential buildings. Additionally, there are several family camps along the island's coastline. The exact number of these is not known. Based on community discussions, these are areas or structures (permanent or semi-permanent) used by families to spend time near the ocean.

There is a long wait list for housing on the island, with people having to wait without a house, sharing homes or living on the mainland for many years.

Based on project team observations and community testimony, the social housing design on Masig Island is not always designed with energy efficiency at the forefront of considerations. Almost all homes have dark-coloured Colourbond roofs, small windows with no considerations for local conditions such as natural shade and natural air circulation.

There is no emergency centre or cyclone shelter on the island, however Masig is not typically impacted by cyclones due to its northerly latitude.

7.4.6 Projected Climate Change Impacts

Projected climate change risks include warming of air and sea temperatures, rising sea levels and ocean acidification. Coastal hazards such as erosion and storm tide inundation are already experienced and affecting the community. These impacts will likely be exacerbated by climate change, sea level rise and the flat topography of the island, limiting the options to relocate to safer areas on the island.

The TSIRC planning scheme mapped natural hazards for terrestrial and coastal disasters (Figure 32 and Figure 33)[48]. For Masig, bushfires were considered a moderate hazard. They are predicted to occur mostly on the western side of the island, which is mostly covered by a dense shrub type

[48] (Torres Shire Council, 2015)

forest. Storm tide inundation predictions are more prevalent and widespread across the island with the eastern and southern parts most vulnerable, which is most likely due to its flat topography of the island. The eastern and southern parts of the island are more vulnerable to storm tide impacts, due to lower topography.

Figure 32: Map of natural hazards on Masig Island (Planning scheme for the Torres Strait Island Regional Council area, 2015)

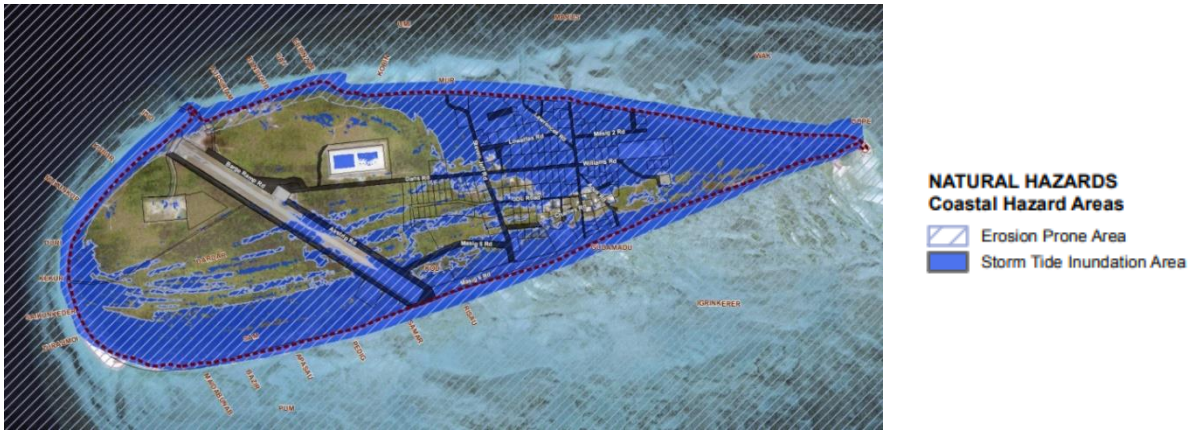

Figure 33: Map of coastal hazards on Masig Island (Planning scheme for the Torres Strait Island Regional Council area, 2015)

During consultations, the community named king tides and storm surges causing erosion and inundation as the main risks posed by severe weather events. Being a low-lying coral cay makes the island extremely vulnerable to these events. Rising sea levels would directly correlate to an increase in the Highest Astronomical Tides (HAT) levels and would exacerbate the impacts of such events as well as rain induced flooding, as illustrated in Figure 34.

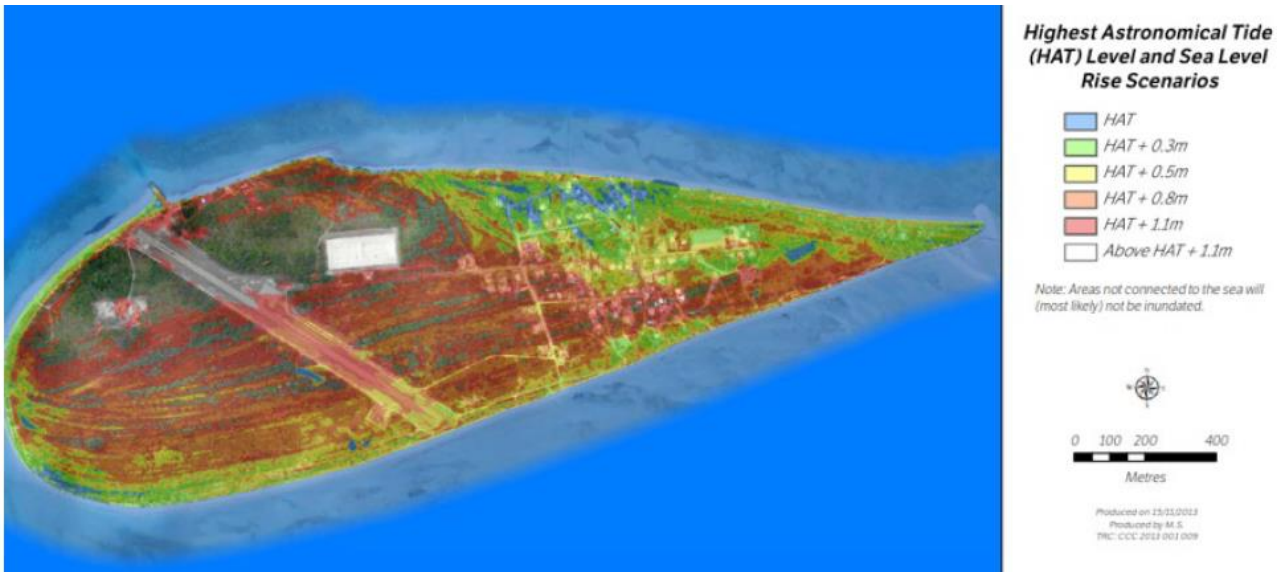

Figure 34: Highest astronomical tide (HAT) level and sea level rise scenarios[49]

This model very clearly illustrates the severity of sea level rise combined with HAT events, effectively inundating the whole island. The impacts of these weather events can be intensified by poorly designed coastal infrastructure (such as the boat ramp), inappropriate development along coastlines and poor housing design (homes built too low that are prone to flooding).

In terms of erosion, the windward (southern) side of Masig Island is degrading (erosion) due to loss of sand. Based on community discussions, sand only accumulates around the island during full and dark moons. The community is concerned about the gradual loss of sand, which is eroding the island's inhabitable area as well as culturally significant sites such as the cemetery.

Furthermore, the jetty on the northern part of the island has been identified as limiting natural sand movements. The construction of this type of perpendicular harbor infrastructure including a rock and cement barge ramp has disrupted natural beach processes on the north-western shore of the island.[50] This has resulted in sand accumulating on the western side of the jetty and loss of sand directly to the east of the jetty. It is estimated that the eroding area (eastern side of the jetty) is losing approximately 120 m3 per annum, while the western side of the jetty has a surplus of approximately 700m3 of sand. There have been discussions of artificially moving sand to the east in order to re-establish and maintain near-normal sand levels.[51] The process of sand bypassing at this point would have to be an ongoing operation or performed on a regular basis in order to compensate for the disruption in natural sand movements.

7.5 Community Preparedness and Self-sufficiency

[49] (CoastAdapt)

[50] (Duce, Parnell, & Smithers, 2008)

[51] (Torres Strait Regional Authority, 2016)

Masig Island is dependent upon external sources for the delivery of its food supply. The IBIS shop receives a delivery of food twice a week via a barge from Thursday Island. Community Enterprise Queensland (CEQ) is an unfunded not for profit Queensland Government Statutory Board which is registered as a charity by the Australian Taxation Office. It operates under the auspices of the Aboriginal and Torres Strait Islander Communities (Justice, Land and Other Matters) Act 1984. The IIB trades as the Islanders Board of Industry and Service (IBIS). Fresh food is not plentiful on the island and is available on a first-come-first-serve basis. There have been times when the island has been cut-off from food deliveries for up to four weeks due to high winds. Information around food reserves were not available, but it is understood that a great deal of food during these periods comes from fishing in the nearby waters.

Masig Island is fortunate to have rich seas, providing fish and a range of other seafoods (crayfish, beche de mer, finfish) which not only provide income for many Islanders, but are an important source of food for the community year-round.

However, it was reported by community members that some fish stocks are occasionally being used in unsustainable ways by the community. Reportedly, the sardine patches near the jetty (deeper water close to shore) provide an easy catch for families without a boat or not wanting to go out to fish. The overuse of this patch was reported to reduce available bait which is known to incentivise larger fish to come within fishing range for these same residents.

Furthermore, it was raised by residents that the coral reefs immediately adjacent to the island should be left unharvested in order to provide in emergency situations and food restrictions. This is not currently being done but is being suggested by certain community members.

Self-sufficiency on Masig is heavily linked to the availability and supply of energy, which is dependent on the regular delivery of diesel to the island. In terms of energy reserves, Ergon Energy ensures that enough diesel is stored on the island for 78 summer days (summer days are the most energy intensive due to water usage and refrigeration)[52]. This substantial fuel reserve can run the generators, but the vulnerability around power lines failing remains (which is often the cause for blackouts on the island). In the case of isolation due to access restrictions, this would prevent technicians from accessing the island to repair the lines, effectively resulting in a blackout scenario.

[52] (Torres Strait Local Disaster Management Group, 2016)

Furthermore, there is a critical relationship between energy and the supply of potable water, as pumps are required to circulate the water throughout the island as well as run the desalination plant. Based on community testimony, this has not historically been an issue, as power blackouts do not historically last for more than 2 days. There are solar PV installations at the desalination plant, but it is not known how this energy is used during blackout events. More information is needed on the holding capacity of the concrete water pressure holding tank which distributes potable water throughout the community. Based on information provided by TSIRC, in the event of a blackout, this tank holds the quantity of water which can be distributed directly to homes on the island. In the event of a prolonged blackout, depleting the pressure tank's reserves, the concrete lagoon holds up to several month's supply of potable water, greatly extending the community's self-sufficiency, if full.

Another key issue surrounding resilience is cellular reception on the island. Communication blackouts can occur on the island, isolating the community (except for satellite phones). These blackouts reportedly last a highly variable amount of time (hours to days), depending on the cause and are not necessarily associated with a power outage, as Ergon has a generator for the cellular tower. During the project team's second visit, a communications blackout occurred for over half a day. Furthermore, in the event of a communication blackout, no one can access money, get paid or pay bills. The automatic teller machines (ATMs) and EFTPOS stop working, effectively cutting the community off from their money and their capacity to conduct business. This issue was often raised by the community and is currently being investigated by TSIRC.

In the past (when community elders were young), there have been farming activities on Masig and surrounding islands. Sweet potatoes, manioc, corn, pumpkin and watermelon were grown with great success. These are no longer grown, as use of the IBIS shop has increased and reduced the need or the desire for local agriculture. Pigs and ducks were also raised but removed due to government regulation and reef protection policies. Today, only a few backyard gardens provide food to their owners and dogs have replaced farm animals. The community justified this trend by explaining that buying food from the grocery store is much simpler, easier and faster. This more convenient option has reduced or eliminated the need for subsistence agriculture, leading to its disappearance. The convenience of buying groceries from IBIS has been identified as an important hurdle by the community in reinstating agriculture on Masig.

7.6 Disaster Planning and Evacuation Arrangements

Masig is included in the Torres Strait Local Disaster Management Plan, which encompasses both the Torres Shire Council as well as the Torres Strait Island Shire Council. This plan was approved in June 2016[53]. This plan covers how the region identifies and deals with disaster risk management, prevention, preparedness, response, and recovery. The primary focus of the Torres Strait Local Disaster Management Group is to mitigate the effects of disasters in the communities wherever possible or practical, and bolstering preparedness to respond when disasters occur.

[53] (Torres Strait Local Disaster Management Group, 2016)

7.6.1 Insurance Profile

Insurance premiums are considerably higher in Northern Australia including north Queensland than the rest of the Australian territory. The Torres Strait has one of the highest average insurance premiums for home and contents in Australia at $4,224 in 2017/2018[54]. Thereby, most residents do not insure their property. The DHPW carries insurance for the public housing on the island. Insurance premiums in northern Queensland are much greater than other parts of Australia due to their exposure to extreme weather events and rebuilding costs, which are up to 42% higher than in the south[55]. Since 2011, disaster reconstruction costs in the Far North Queensland region totalled $927 million[56].

[54] (Australian Competition and Consumer Commission, 2018)

[55] (Insurance Council of Australia, 2018)

[56] (Queensland Reconstruction Authority, 2019)

8 RISK ASSESSMENT

8.1 Introduction

EarthCheck conducted a high-level island-wide Risk Assessment as part of the Decarbonisation of the Great Barrier Reef Island project. The Sustainability Assessment informed the development of the Risk Assessment, which was then in turn considered in the Options Development and consequent project options, as can be seen in Figure 35. The risks identified in the risk assessment were utilised as guidelines for the development of the options longlist and during the shortlisting process. The risk table in Appendix 2: Masig Island Risk Assessment identifies which project options and longlist options relate to the identified risks.

The risk assessment also forms an important situational analysis for the community and stakeholders, which can be used as appropriate after the project delivery to guide future discussions around risk and community resilience.

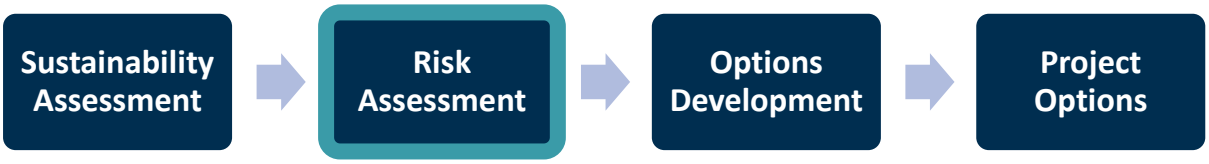

Figure 35: How the risk assessment fits into the project methodology

8.2 Methodology

The following method was applied by EarthCheck to assess the high-level risk of Masig Island against 13 Key Performance Areas.

The EarthCheck Destination Standard identifies 13 Key Performance Areas for a region which were used as a base to identify risk aspects. To adapt these areas to this project, each of these areas were allocated to one of the key project themes, seen below in Table 10.

Table 10: Key project theme's correlation to EarthCheck's Destination Standard key performance areas

Key Project Themes	EarthCheck Destination Standard 13 Key Performance Areas
Energy Production and Efficiency	1. Energy Efficiency, Conservation and Management 2. Greenhouse Gas Emissions
Water and Wastewater	3. Management of Freshwater Resources 4. Wastewater Management, Drainage and Streams
Waste and Recycling	5. Solid Waste Management

Transportation	6. Transport
Resilience and Self-Sufficiency	7. Air Pollution, Noise Control and Light Pollution 8. Ecosystem Conservation and Management 9. Land use Planning and Development 10. Management of Environmentally Harmful Substances 11. Cultural and Social Management 12. Economic Management 13. Resilience

A **Risk** was defined as the chance of an environmental, cultural, social and/or economic impact happening as a result of the activities undertaken by or presence of a destination.

An **Aspect** was defined as an element of the destination that interacts or has the potential to interact with the environment, cultural/social activities and/or the economy.

Once the key performance areas had been mapped against the key project themes, and risks and aspects were defined, the following steps were followed to identify, define, determine and evaluate the risks:

1. Identify actual and/or potential impacts with regards to aspects. This was informed by the Sustainability Assessment. EarthCheck's proprietary benchmarking software was used to catalogue, organise and contextualise the information.
2. Define categories representing the severity of actual and/or potential impacts (refer to Table 11)

Table 11: Severity evaluation

Category	Definition
1	**Limited:** impact to a local area but no long-term effects; concern or complaints from neighbours; no injury to people; minor technical nonconformity but no legal nonconformity.
2	**Minor:** Localised short to medium term impact; minor contribution to global warming; minor and reversible human health impacts treatable with first aid; negative publicity from local media; minor breach of legal requirements.
3	**Medium:** Localised medium to long term impact; moderate contribution to global warming; moderate human health impacts requiring medical treatment; regional media attention; moderate breach of legal requirements with fine.
4	**Major:** Widespread, medium to long term impact; serious human health impacts; state-wide or national attention; major breach of legal

	requirements; major disruption to operations; Destination's reputation badly tarnished.
5	**Catastrophic:** Widespread, irreparable environmental, cultural, social and/or economic damage; loss of human life or long term human health effects; national attention; serious litigation.

3. Define categories representing the likelihood of impacts (refer to Table 12)

Table 12: Likelihood evaluation

Category	Definition
1	**Rare:** Impact would occur only in exceptional circumstances.
2	**Unlikely/Annually:** Impact could occur but is not expected, or will occur annually.
3	**Possible/Monthly:** Impact could occur, or will occur on a monthly basis.
4	**Likely/Weekly:** Impact will probably occur in most instances.
5	**Certain/Daily:** Impact is expected to occur in most circumstances, or will occur on a daily basis.

4. Define categories representing the risk evaluation (refer to Table 13)

Table 13: Risk evaluation matrix

Likelihood	Severity					
	1	2	3	4	5	
1	1	2	3	4	5	Low
2	2	4	6	8	10	Medium
3	3	6	9	12	15	High
4	4	8	12	16	20	Severe
5	5	10	15	20	25	Extreme

5. Determine the severity of potential and/or actual impacts and assign each to a severity category, which was informed by the Sustainability Assessment.
6. Determine the likelihood of potential and/or actual impacts and assign each to a likelihood category, which was also informed by the Sustainability Assessment.
7. Evaluate the risk by using the risk evaluation matrix

8.3 Analysis

In order for the Risk Assessment to be considered in the Options Development and consequent project options, the results of the Risk Assessment (presented in Appendix 2: Masig Island Risk Assessment) were plotted into Figure 36 and Figure 37. This overview illustrates Masig Island's overall risk profile as well as the number of risks for each risk severity category broken down into the different project themes.

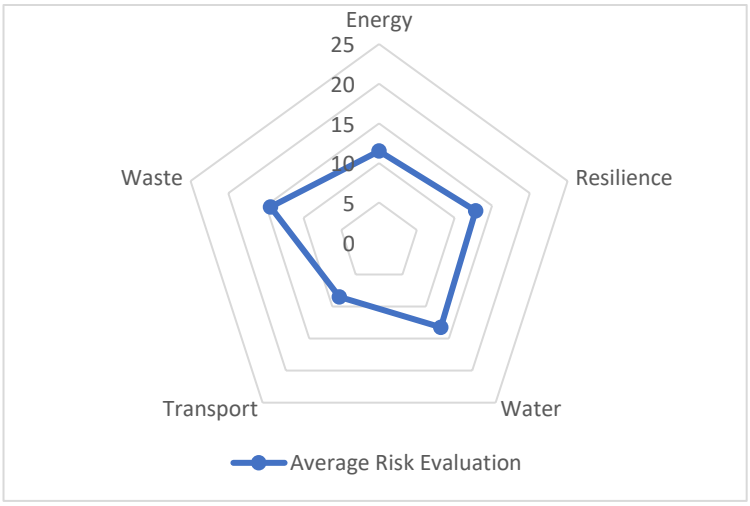

Figure 36: Risk profile for Masig Island

Figure 36 presents Masig's risk profile by plotting average risk scores by risk theme. The figure illustrates that waste has the highest risk profile, followed by water, resilience, energy, and transport.

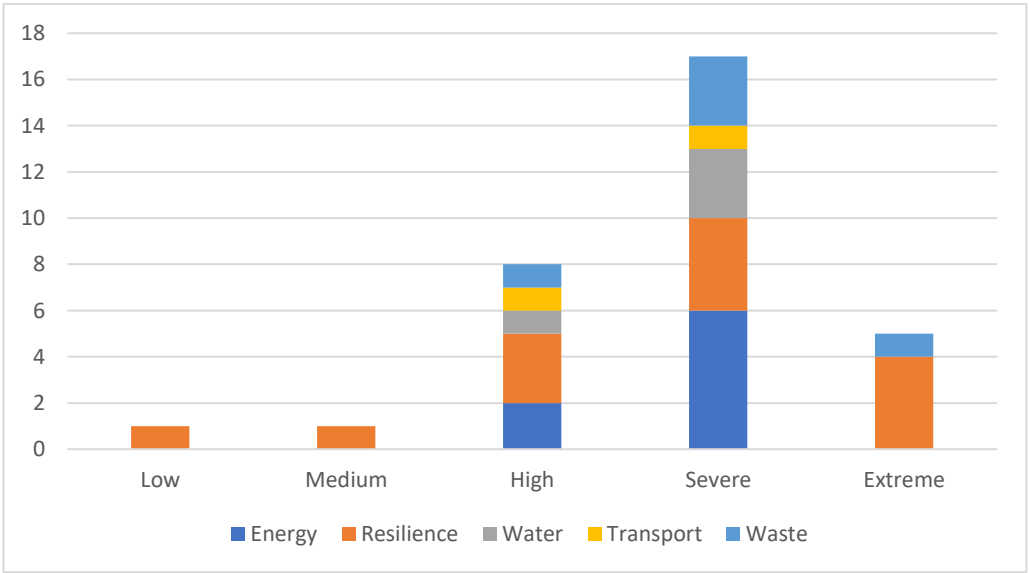

Figure 37: Risk breakdown for Masig Island

Figure 37 shows how the risk themes are spread across the risk categories (the numbers on the y-axis representing the number of risks). The "severe" and "high" risk severities are the most represented risk categories and both include at least one risk from each of the five themes. Only waste and resilience have "extreme" risks identified by this Risk Assessment. Effectively, the "severe" risk category includes the highest numbers of risks, highlighting the critical need for action and risk mitigation.

The Risk Assessment identified if there were current mitigation strategies in place for the risks identified. A summary table (Table 14) has been provided below of potential impacts with little to no current mitigating strategies observed.

The potential impacts identified as having either a high, severe or extreme risk with little to no current mitigating strategies observed, were considered when creating the long list of decarbonisation options in phase two of the project. This was done with the aim of providing potential solutions to assist with risk reduction on the island.

The full Risk Assessment can be referred to in Appendix 2: Masig Island Risk Assessment.

Table 14. Summary of potential impacts with little to no mitigation strategies observed

Risk Evaluation	Potential Impact(s)	Current Minimisation / Mitigation Strategy Observed
High	Renewable energy accounts for a small proportion of total energy generated.	Some solar photovoltaic and solar hot water systems. No current mitigating strategies observed.
	Lack of auxiliary power supply at plant leading to risk of failure should the primary power supply fail.	No current mitigation strategies observed beyond Ergon contingency plans.
	High costs associated with removing waste off the island as there is no on-island waste treatment facility.	No current mitigation strategies observed.
Severe	Use of non-renewable fuel consumption in transportation to and from the island contributing to climate change.	No current mitigating strategies observed.
	Potential for ozone depleting substances to release gases harmful to human health (e.g. from fridges, air conditioning equipment etc.).	No current mitigating strategies observed.
	Onsite storage and incineration of sludge due to the high cost of transporting this to the mainland which	No current mitigating strategies observed.

	could impact local ecosystems and the community.	
	Reliance on external transport providers to bring visitors, workers and residents on and off the island, including evacuations during extreme weather events.	Some residents may use personal boats to travel from Masig to surrounding Islands. No other current mitigating strategies observed.
	Contamination of land and sea ecosystems from disused vehicle waste across the island.	No current mitigating strategies observed.
	Greenhouse gas emissions from waste buried and incinerated on-island.	No current mitigating strategies observed.
	Long waitlist for social housing.	No current mitigating strategies observed.
	Power outages cut cellular reception and payment services (except for satellite phones) isolating the community.	No current mitigating strategies observed.
	High reliance on food delivered from the mainland as limited food grown on Masig Island.	Although there are a small number of backyard gardens as well as fishing, there are no current mitigation strategies in place.
Extreme	Extreme weather events leading to the island being cut-off from the mainland. This leads to a range of issues including evacuations for health reasons, reduced access to power, water, roads cut to critical infrastructure, telecommunications etc.	No current mitigating strategies observed.
	Projected climate change risks include increased temperatures, increased average annual rainfall, increases in the wind speed of tropical cyclones and a decrease in ocean PH (ocean acidification).	Complaint against the Australian Government to the UN Human Rights Commission has increased awareness of their issues.

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APPENDIX 1 MASIG ISLAND COMMUNICATION AND ENGAGEMENT PLAN

The following pages outline the Communication and Engagement Plan that has been designed to inform the sustainability audit, options analysis and project options development. Included in the plan is a cultural engagement strategy for Masig Island.

OVERVIEW

EarthCheck led a team of consultants including ARUP, Regional Economic Solutions (RES) and Queensland Tourism Industry Council (QTIC) to deliver the Decarbonisation of the Great Barrier Reef Islands – Whole of Island Community Pilot Project for Masig Island. This project was carried out for the Department of Environment and Science (DES) in close collaboration with the Department of Aboriginal and Torres Strait Islander Partnerships (DATSIP).

Appropriate and respectful community and stakeholder engagement was key to the successful delivery of the Project and the sharing of community knowledge to understand issues and barriers and identify achievement opportunities for the island.

This Communications and Engagement Plan has been designed to inform the sustainability audit, options analysis and project options development. Included in this plan is a cultural engagement strategy for Masig Island prepared by RES (with review by QTIC) that:

- Recognises and respects cultural knowledge and experience
- Includes both men's and women's business and perspectives
- Is sensitive to historical and political experiences of First Nation peoples
- Is sensitive to Island specific cultural protocols and socio-economic issues

This plan presents the engagement approaches and an outline of the communications and engagement with the community and key stakeholders, setting out the roles and responsibilities of players. A list of engaged stakeholders is also included.

1. PROJECT OBJECTIVES

The Project objective was to deliver a Great Barrier Reef (GBR) Decarbonisation Program for the island community of Masig Island. DES is helping GBR Island communities by identifying opportunities and project options to enable transition to low carbon economies and become more resilient to changes in climate. Masig Island presented unique challenges for decarbonisation and resilience with the added opportunity of learning from and incorporating First Nation community knowledge into the decarbonisation and resilience efforts.

The Whole of Island Community Pilot Project worked with the community to identify opportunities for new technologies, innovations and best practices, and ensure community has sufficient information (project options) to seek funding opportunities. These will reduce greenhouse gas emissions and provided additional benefits such as:

- Ownership of projects and input into the work going forward
- Identify opportunities for local employment and economic development

- Identify cluster opportunities for implementing solutions with neighbouring islands and communities

The project was constituted of three phases that led to the presentation of the final Project options to the island community. These phases were:

1. The Sustainability Assessment

The sustainability assessment involved off-site and on-site data collection on five key areas (energy, waste management, water, transport, and resilience). During the first on-island visit, the team spent three days engaging with the community and key stakeholders, building relationships as well as collecting a range of information (qualitative and quantitative).

2. The Options development

The options development involved compiling a list of options for reducing emissions, increasing resilience to climate change and identifying new opportunities. The impact and feasibility of each of these was evaluated by the project team and a panel of industry experts. During the second on-island visit, the community tailored these options and provided feedback to ensure alignment with key community needs.

3. The project options development

The project options development involved developing packages for Masig Island. These went through a rigorous cost-benefit analysis which investigated on-island employment opportunities. During the third on-island visit, the community had the opportunity to tailor these project options and provide supplementary feedback to ensure appropriateness and project success.

Each of these phases involved communicating and engaging with key island stakeholders such as local councils, community leaders, as well as organisations and service providers.

2. COMMUNITY AND STAKEHOLDER ENGAGEMENT METHODOLOGY

Masig Island required a tailored engagement strategy to facilitate communications between the project team and the community. Understanding this for Masig Island and having an adapted stakeholder approach was a key success factor.

The community engagement strategy rests upon the Moon-da-gatta (Yarning Framework) which was used to engage residents and, in particular, First Nations people. This is a cultural tool which was facilitated by RES to share and gather information where the elders, young people and local leaders are respected as knowledge holders in their community.

This was complemented by the widely accepted community engagement techniques as well as cultural engagement tools. The International Association for Public Participation (IAP2) Engagement spectrum which outlines the level of public participation by stakeholder groups depending on their level of interest in the project has guided the engagement techniques developed for the project.

The team employed both approaches to communicate and collaborate with key stakeholders and community on Masig Island. These are described further below.

2.1 RES (Moon-da Gatta) Yarning Framework

In collaboration with the local Island community, the project team worked to share principles of engagement from First Nation perspectives. This approach is best practice in relation to place based and healing informed initiatives and will guide engagement and discussions with the community. This Yarning-up Engagement and Yarning-up Delivery framework defines the cultural and corporate elements of success. This framework helps to identify the community's strengths and works from a position of co-design where the community is central and decision making a fundamental principle.

The strength of the framework is engagement through a First Nation lens that identifies and celebrates the strengths of individuals and the collective through processes of self-disclosure and storytelling. RES's framework empowers participants and provides a platform to self-determination. The model to success is described below.

RES's Yarning Framework Moon-da-gatta is a Bidjara word meaning creator or to create. Moon-da-gatta is a Strength Based process and is the bedrock which sits at the centre guiding our community engagement principles. It is based on respect, responsibility, and relationships. The diagram below (Figure) highlights the key milestones of the engagement processes each having a function and deliverable towards self-determination.

Figure 1: The Moondagatta Yarning Framework, RES

1. **Discover**: Appreciating "the best of what is". The physical, geographical, social, emotional and spiritual elements of the area and its people.
2. **Understand**: Dreaming process "What might be" (based on aspirations, individual and community strengths)
3. **Negotiate**: "Yarning to work together" (what processes need to be set up to begin the process of designing and collaborating now and into the future)
4. **Implement**: Recognising assets & gaps. (Project Delivery and communicating the intentions)
5. **Take Stock**: Reviewing milestones previously negotiated
6. **The Future**: What next to self determination

The information and advice identified through the Yarning process informed the content, delivery and implementation methods, expectations and duration of support required resulting in a program that is unique to the community and the diverse cohort.

2.2 IAP2 and General Engagement Techniques

The Communications and Engagement Plan is based on the four pillars of the IAP2 Stakeholder Engagement Spectrum – Inform, Consult, Involve and Collaborate. For this project, the multiple engagement strategies outlined in the IAP2 framework were used as needed to maintain stakeholder engagement.

For the project to provide the most successful and beneficial outcomes, the consultation and engagement process with the stakeholders and communities on-island needed to build trust and gain support for any preferred options. The key stakeholders included the residential community, local Councils, business operators, transport providers, state and/or national government departments operating on the island as well as any tangible links to surrounding islands or the mainland. A detailed framework of the IAP2 approach is included in Section 4.

The key engagement tools identified in this framework that are relevant to the project include:

Inform

- Push and pull communications
- Project Website
- Local Media (paper, radio, TV, internet, social media)
- Public displays/exhibitions
- Existing community organisation networks
- Environment, recreation, sport, tourism and business networks
- Council's range of communication channels

Consult/Involve/Collaborate

- Project presentations
- Community forums and workshops
- Face to face meetings
- Surveys
- Community Drop in Sessions
- Emailing feedback
- Key Influencer Engagement
- Industry technical forum

3. COMMUNICATION AND ENGAGEMENT PLAN

The action plan for community engagement for Masig Island is based on the following principles that are used to gain maximum communication and engagement. These principles ensure the community is:

- Advised of the project intent and their thoughts sought
- Engaged in the Yarning Framework to help develop understanding and express their views
- Shown how this project could benefit the community
- Asked if they have had similar initiatives in the community previously
- Asked if there is First Nation cultural knowledge that people would like to share and have recorded
- Engaged in negotiating an engagement and decision-making process throughout the project stages and seek feedback regarding the planning and implementation processes
- Engaged in identifying and reviewing a range of opportunities that consider individual residents, businesses, community organisations and other stakeholder groups
- Provided with updates about the project and progress on milestones
- Advised of previous projects and or studies that have been considered and views or feedback will also be sought to ensure the results continue to be relevant

The following tables present the key communication and engagement considerations for Masig Island throughout the project. Table 1 provides an overview of the key stakeholder

groups engaged in the project. Table 2 provides an overview of key actions implemented through each phase of the project.

Table 1: Key stakeholder groups for Masig Island

Community/ Stakeholder	Engagement
Government (State) Level of interest: Likely to be a very high level of interest due to alignment with policy objectives, opportunities for infrastructure enhancement and long-term planning and development	IAP2 Spectrum: Collaborate • Guide, support and facilitate project delivery • Review and feedback on reports and presentations including providing sign-off on key findings
Local Council Level of interest: Likely to be a very high level of interest due to alignment with policy objectives, opportunities for infrastructure enhancement and long-term planning and development	IAP2 Spectrum: Collaborate • Council will have multiple resources involved in the project operational team • Council to take ownership of the project and help guide, support and facilitate project delivery • Council to assist with project-related communications and with venues for meetings and community gatherings (if possible)
Utility providers Level of interest: Likely to be a very high level of interest due to opportunities for infrastructure enhancement and long-term planning and development	IAP2 Spectrum: Collaborate • Guide, support and facilitate project delivery • Review and feedback on reports and presentations including providing sign-off on key findings
Community associations Level of interest: Likely to be a medium - high level of interest due to community development outcomes, opportunities for infrastructure enhancement and long-term planning and development	IAP2 Spectrum: Collaborate • Guide, support and facilitate project delivery • Review and feedback on reports and presentations including providing sign-off on key findings • Assist in the dissemination of project-related information throughout respective networks
Businesses (retail, accommodation, transport) Level of interest: Likely to be a medium – high level of interest as an opportunity to reduce business operation costs and support resilience of Island business, tourism and future development	IAP2 Spectrum: Involve • Participate in the project through all available avenues and provide input and feedback
Traditional owner representatives Level of interest: Likely to be a medium – high level of interest as reducing costs of living and supporting greater Island self-sufficiency and opportunity	IAP2 Spectrum: Involve • Lead community input and cultural knowledge into the project • Review and feedback on reports and presentations including providing sign-off on key findings

Community/ Stakeholder	Engagement
Community providers (schools, health, churches, sport) Level of interest: Likely to be a medium – high level of interest as reducing costs of living and supporting greater Island self-sufficiency and opportunity	IAP2 Spectrum: Involve • Participate in the project through all available avenues and provide input and feedback
Residents Level of interest: Likely to be a medium – high level of interest as reducing costs of living and supporting greater Island self-sufficiency and opportunity	IAP2 Spectrum: Involve • Participate in the project through all available avenues and provide input and feedback
Other stakeholder groups (technology providers, neighbouring Islands) Level of interest: Likely to be a medium level of interest as opportunities identified for these Islands may open be broadened to wider GBR region	IAP2 Spectrum: Inform • Inform

Table 2: Masig Island Communications and Engagement Plan

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
Masig Island Stakeholder groups (Residents, Traditional Owners, Businesses, Community associations, Community providers, Transport operators, Other stakeholder groups)	1 Sustainability Assessment	Island-specific poster detailing project and first visit information such as time and place of drop in sessions. Shared via community groups, print and other	09.09.19	EC	RES, QTIC, Arup, DATSIP, DES, Council	DES	EC, Council, key stakeholders, media
		Island-specific web page presenting the project, the timeline, the project team and other important resources	09.09.19	EC	RES, QTIC, Arup	DES	EC
		Community drop-in sessions and meals to present project to community and collect qualitative and quantitative information about the island	10.09.19 11.09.19 12.09.19	EC	EC, RES, QTIC, Arup	none	EC, RES, QTIC
		Indigenous and Traditional Owner groups are met with to develop relationship, project buy-in and contextual information. Steps 1, 2 and 3 from the RES Yarning Framework were employed in this phase (Discover, Understand and Negotiate)	09.09.19	RES	RES	None	RES
		Online survey to collate island data regarding energy, water, waste, transport and resilience. Distributed via email and on-island community groups (Council, My pathway, School, etc)	TBC	EC	RES, QTIC, Arup	DES	EC, Council, Key stakeholder groups

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
		Data requests to key stakeholders to collate information concerning energy, water, waste, transport and resilience. Distributed via phone calls, interviews or email	Throughout phase	EC	DES, Arup	DES	EC
	2 Options Development	Island-specific poster detailing the project and second visit information such as time and place of options development workshops. Shared via community groups, print and other	25.11.19	EC	RES, QTIC, Arup, DATSIP, DES, Council	DES	EC, Council, key stakeholders, media
		Flyer presenting project methodology and structure updated for the second visit with key information. Hard copies only distributed in person on-island	25.11.19	EC, RES, QTIC, Arup	RES, QTIC, Arup, DATSIP, DES	DES	EC, RES, QTIC, Arup
		Workshop briefing pack to prepare attendees for the workshop and guide the discussion	25.11.19	EC, RES, QTIC, Arup	RES, QTIC, Arup	DES	EC, Council, Key stakeholders
		Indigenous and Traditional Owner groups are met with to further develop relationship, project buy-in and contextual information. Steps 3, 4, 5 and 6 from the RES Yarning Framework were employed in this phase	09.12.19	RES	RES	None	RES

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
		(Negotiate, Implement, Take Stock and The Future)					
		Workshops to present options short list and collect community input on gaps, applicability and other details	09.12.19	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES to approve content	EC, RES, QTIC, Arup
	3 Project Option Development	Island-specific poster detailing the project and third visit information such as time and place of project options development workshops. Shared via community groups, print and other	02.03.20	EC, RES, QTIC, Arup	RES, QTIC, Arup, Council, DATSIP, DES	DES	EC, Council, key stakeholders, media
		Flyer presenting project methodology and structure updated for the third visit with key information. Hard copies only distributed in person on-island	02.03.20	EC, RES, QTIC, Arup	RES, QTIC, Arup, DES, DATSIP	DES	EC, RES, QTIC, Arup, Council, Key stakeholders
		Workshop briefing pack to prepare attendees for the workshop and guide the discussion	02.03.20	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup, DES, DATSIP	DES	EC, Council, Key stakeholders
		Indigenous and Traditional Owner groups are met with to further develop relationship, project buy-in and contextual information. Steps 3, 4, 5 and 6 from the RES Yarning Framework were employed in this phase	16.03.20	RES	RES	None	RES

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
		(Negotiate, Implement, Take Stock and The Future)					
		Workshops to present project options and collect community input on gaps, applicability and other details	16.03.20	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES to approve content	EC, RES, QTIC, Arup
	4 Final Report	Island-specific poster detailing the project and fourth visit information such as time and place of final report presentation. Shared via council, community groups and other	06.04.20	EC, RES, QTIC, Arup	RES, QTIC, Arup, Council, DES, DATSIP	DES	EC, Council, key stakeholders
		Final community report and project options to be presented to key community contacts and project champions	20.04.20 27.04.20	EC, Arup	RES, QTIC, Arup, DES	DES, Council, Key stakeholders	EC
		Community meeting to present the project results, hand over the project options and thank the community for their engagement and welcome into their communities	20.04.20 27.04.20	EC	RES, QTIC, Arup, DES, DATSIP	DES, Council	EC
Torres Strait Island Regional Council	1	Project summary (4-pager) providing a detailed portrait of the project, the timeline, the project team as well as	26.08.19	EC, RES	EC, RES, QTIC, DES, DATSIP	DES	EC

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
	Sustainability Assessment	what councils and key stakeholders can do to help the project succeed					
		Online survey to collate island data regarding energy, water, waste, transport and resilience. Distributed via email	07.10.19	EC	RES, QTIC, Arup, DES, DATSIP	DES	EC
		Sustainability Assessment Report presenting the findings of the Sustainability Assessment phase and first site visit	TBD	EC	RES, QTIC, Arup, Council, DES	DES	EC
	2 Options Development	Workshop briefing pack to prepare attendees for the workshop and guide the discussion	25.11.19	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES	EC, Council, Key stakeholders
		Workshop to present options short list and collect Council input on gaps, applicability and other details	09.12.19	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	none	EC, RES, QTIC, Arup
	3 Project Option Development	Workshop briefing pack to prepare attendees for the workshop and guide the discussion	02.03.20	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES	EC
		Workshop to present project options and collect Council input on gaps, applicability and other details	16.03.20	EC, RES, QTIC, Arup	EC, RES, QTIC, Arup	DES	EC, RES, QTIC, Arup

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
	4 Final Report	Final report and project options to be presented to Council contacts	20.04.20 27.04.20	EC, RES	EC, RES, QTIC, Arup, Council	DES	EC
		Council meeting to present the project results, hand over the project options and thank the Council for their engagement	20.04.20 27.04.20	EC	EC, RES, QTIC, Arup	none	EC
Government and industry experts	2 Options Development	Options briefing pack to prepare distribution group for feedback and guide discussions	07.10.19	EC	EC, Arup, DES, DATSIP	DES	EC, DES, DATSIP
		Materials distributed to present options and collect input on project alignment, gaps, applicability and other details	17.10.19	EC	EC, Arup, DES, DATSIP	DES	EC, DES, DATSIP
	3 Project Option Development	Project options workshop briefing pack to prepare attendees for the workshop and guide the discussion	03.02.20 24.02.20	EC	EC, Arup, DES, DATSIP	DES	EC, DES, DATSIP
		Workshop / Survey to present project options and collect input on project alignment, gaps, applicability and other details	03.02.20 24.02.20	EC	EC, Arup, DES, DATSIP	DES	EC
Project Operational Group	Throughout project	Meeting to discuss project advancement, community engagement, ownership and alignment	TBC	EC	EC, Arup, DES, DATSIP	DES	EC, RES, QTIC, Arup, DES, DATSIP

Audience / Recipient	Project Phase	Description	Delivery (week)	Creator / Organiser	QA	Approval	Distributor
(See table 1 for members)							
Media	Throughout project	All communications with media will be managed by DES. Advice from DES media is that any news outlets should contact DES media at Media@des.qld.gov.au for any inquiries.	All	DES	EC, RES, QTIC, Arup, DES, DATSIP	DES	

4. IAP2 APPROACH AND PROJECT ENGAGEMENT TECHNIQUES

IAP2 approach	
Engagement Principles	**Engagement was inclusive** which means ensuring that everyone who may have an interest in the outcome had an opportunity to participate.
	A **range of engagement techniques** were employed for industry, community and other stakeholders based on the IAP2 spectrum of inform, consult, involve, collaborate and empower.
	The **timing and purpose** of each stage of engagement was clearly linked to each stage of project options development.
	There was a clear commitment to the provision of **accurate and timely information**, and a process to confirm that feedback is being heard.
	The **diversity of views in the community** were acknowledged and respected in accordance with relevant procedures and customs for the island.
	Engagement was **flexible and responsive** community needs to ensure that the process builds buy in and ownership from stakeholders and community.
Engagement Objectives	Communicated **broadly to the community and key stakeholders** to inform them about the development and progress of the Project throughout its life-cycle.
	Worked directly with key stakeholders to ensure that their aspirations were understood, and their local knowledge and experience was integrated into the project options.
	Cuilt a strong partnership with the stakeholders throughout the development of the project options that enabled support and effective implementation.
	Ensured the **diversity of community voices** were reflected in the engagement process, and that **diverse opportunities** were created for the community to be informed about and have input into the development of the project options.
	Provided **clarity and transparency** about how community and stakeholder input has influenced the development of the project options.
Engagement approach	**Informing** This engagement approach focused on getting the message out to the community and key stakeholder groups of the project, that work had commenced, informed them of its priorities, and how and when all parties were able to get involved. An Engagement Strategy was implemented for the island. It presented an adapted approach, based on its history, culture, available communications streams and used a range of media channels, including: • Project Website • Local Media (paper, radio, TV, internet, social media) • Existing community organisation networks • Council's range of communication channels

IAP2 approach	
	• Community champions Push Communications Information about the project was sent or distributed to relevant stakeholders via a variety of methods. These included mainly e-mails and phone conversations to key stakeholders. Local communications streams were also harnessed to promote project awareness. Notifications were also sent in local media publications. Pull Communications The Project Website Page allowed a wide range of stakeholders to become and stay informed about the project, communicate with the project team as well as provide insight and feedback. The page was added onto the EarthCheck website and presents the project, the project team, the project partners and the project context. A link was made available to stakeholders and partners so they may link to it on their own websites and facilitate the spread of information about the project. Other pull communication methods included publications on local Council's websites or notice boards in various key locations on or around the island. Communication Streams This Project employed a variety of communication streams to achieve its IAP2 engagement approach objectives. These were adapted to the needs of the island.
	Consulting The purpose of this engagement approach was to conduct the sustainability audits and on-site research by successfully gathering high quality consultative input from the community and stakeholder groups. On-island and relevant off-island groups were included in this phase. Options for consultation included: • Community forums and workshops; • Face to face meetings; • Project webpages; • Sustainability audits • Online and offline surveys • Feedback register Communities We recognise the importance of developing an approach which provides for as wide a range of inputs as possible. This will need to recognise existing issues for all three islands such as location and socio-demographic groups. Where applicable, community champions will be identified and involved to facilitate community engagement and ownership of the project. Presentations

IAP2 approach	
	Presentations used in this project present key project findings, the sustainability options analysis as well as project options to island stakeholders. Furthermore, presentations will also be employed to convey information about the project progress and final deliverables to DES. Cultural sensitivities will be considered and how to best communicate information to diverse audiences. Industry and Stakeholders Industry stakeholders were identified. they were directly communicated if relevant to the project. These stakeholders are listed in the Stakeholder Register. Council Communication We recognise the importance of generating buy-in and input across senior officers and Council teams – all of whom will have a role in supporting the project options. Key contact points for the Council have been identified in the Stakeholder Register. Broader Industry and Technical Engagement EarthCheck engaged technical experts, relevant government agencies such as utility providers and relevant industry representatives such as suppliers of remote island infrastructure in the review and shortlisting of the options and cost benefit analysis of the project options. As part of this process EarthCheck facilitated up to four two-hour options review and project options development workshops in Brisbane inviting relevant participants to attend in person or via weblink. ARUP led engagement of technical experts, relevant stakeholders and/or relevant government agencies for pricing information for use in the project options.
	Involving The involving engagement approach focused on maintaining contact with stakeholders throughout the course of the project and fostering continued interest. Given the timescale over which the project options were prepared, this was an important consideration. As such, the project team proposed utilising the extensive network of existing communication channels to industry, stakeholders and community groups to maintain contact and provide regular updates. Options for involving could include: • Public displays/exhibitions of appropriate options (online/physical); • Open meetings; • Online feedback through project webpages/social media; • Workshops; • Surveys; and • Direct feedback. Community

IAP2 approach	
	Maintaining community buy-in and involvement is a key success factor for this project. For this, it was critical that there be an open and maintained communication stream between the project team and its stakeholders. Options for how this was achieved include: • Project Website/social media; • Open meetings; and • The opportunity for email questions and feedback. <u>Local businesses</u> Local businesses can be important players in a community. It is important to provide these stakeholders with a voice and the opportunity to provide feedback. For this, it is again important that there was open and maintained communication stream between the project team and its stakeholders. Options for how this was achieved include: • Project Website/social media; • Open meetings; and • The opportunity for email questions and feedback. <u>Other Stakeholders</u> Feedback from the community and stakeholders from the Options Workshops and the recommended responses fed into the final project options preparation. <u>Consultation Groups and Workshops</u> Consultation groups and workshops were a critical communication stream and engagement tool for this project. The island was visited to conduct a sustainability audit as well as during options review workshops and the project options presentations. These involved communicating, working and consulting with the community. Cultural sensitivity is a key aspect of this communication stream. RES and QTIC were heavily involved in this process to ensure culturally appropriate interactions with the many different cultural backgrounds involved in the project. This ensured good working relationships as well as promoted positive project outcomes.
	Collaborating The final and perhaps most important stakeholder engagement approach focuses on collaboration – activity which engendered collective ownership of the project options and commitment to being implementation partners. The communication around the final project options provided an ideal opportunity to engender wider understanding and ownership. This was done through: • Council Briefings; • Key Influencer Engagement; and • Integration of feedback into project options.

5. MASIG ISLAND STAKEHOLDER REGISTER

This stakeholder register is up to date as of 22.09.2020.

Position	Business/organisation	Category
	Australian Fisheries Management Authority	Government (Federal)
	Biosecurity and ABF	Government (State)
Project Manager	Climate and Coastal Land and Sea Management Unity, Torres Strait Regional Authority	Government (Federal)
Chairperson	Community Justice Group	Community Associations
Coordinator	Community Justice Group	Community Associations
	Department of Housing and Public Works	Government (State)
Renewable and Strategy Engineer	Ergon Energy	Utility Provider
	Gabaou Mari (catering)	Business and the business community
Senior Lecturer in Environmental Health	Griffith University	Collaborator
	IBIS Grocery Store and Fuel	Business and the business community
Air Charter Consultant	Independent Aviation Charter	Business and the business community
	Islanders Board of Industry and Service	Community Associations
	Kailag Enterprise Limited	Business and the business community
	Kozan Shop	Business and the business community
	Masig Christian Outreach Ministry	Community Provider
	Masig Muysaw Ngurpay Lag Primary School	Community Provider
Chair	Masigalgal Prescribed Body Corporate (PBC)	Traditional Owner representative
Chair	Masigalgal Prescribed Body Corporate (PBC) Corporation RNTBC	Traditional Owner representative
	Primary Health Care Centre	Government (State)

Torres Strait Island Police Support Officer	Queensland Police	Government (State)
Account Manager	SeaSwift	Business and the business community
	SkyTrans	Business and the business community
Head of Campus	Tagai State College	Community Provider
CEO	Torres Strait Islands Regional Council	Government (Federal)
Strategic Sourcing Manager	Torres Strait Islands Regional Council	Local Council
Mayor	Torres Strait Islands Regional Council	Local Council
Manager Engineering Operations	Torres Strait Islands Regional Council	Local Council
Director Engineering and Infrastructure	Torres Strait Islands Regional Council	Local Council
Divisional Manager (Masig)	Torres Strait Islands Regional Council	Local Council
Councillor	Torres Strait Islands Regional Council	Local Council
Acting Executive Manager Engineering Services	Torres Strait Islands Regional Council	Local Council
Senior Project Engineer	Torres Strait Islands Regional Council	Local Council
	Torres Strait Islands Regional Council	Local Council
Engineer Water and Wastewater Compliance	Torres Strait Islands Regional Council	Local Council
Multi Skilled Administration Officer	Torres Strait Islands Regional Council	Local Council
Head of Corporate Affairs and Engagement	Torres Strait Islands Regional Council	Local Council
Director Governance and Planning	Torres Strait Islands Regional Council	Local Council
Campaign and Events Coordinator	Torres Strait Islands Regional Council	Local Council
	Torres Strait Islands Regional Council – Masig Community Tip	Local Council
Board Member (Masig)	Torres Strait Regional Authority	Local Council
Torres Strait Community Tourism Coordinator	Tourism Tropical North Queensland	Business and the business community

	Tourism Tropical North Queensland	Business and the business community

APPENDIX 2 MASIG ISLAND RISK ASSESSMENT

The assessment on the following pages provides an overview of Masig Island's Risk Assessment, including current observed strategies to mitigate or minimise potential and/or actual impacts with regards to the 12 Key Performance Areas of the EarthCheck Destination Standard.

The high, severe, and extreme risks without an identified mitigation strategy or approach are presented below.

High:

- Renewable energy accounts for a small proportion of total energy generated.
- Lack of auxiliary power supply at plant leading to risk of failure should the primary power supply fail.
- High costs associated with removing waste off the island as there is no on-island waste treatment facility.

Severe:

- Use of non-renewable fuel consumption in transportation to and from the island contributing to climate change.
- Potential for ozone depleting substances to release gases harmful to human health (e.g. from fridges, air conditioning equipment etc.).
- Onsite storage and incineration of sludge due to the high cost of transporting this to the mainland which could impact local ecosystems and the community.
- Reliance on external transport providers to bring visitors, workers and residents on and off the island, including evacuations during extreme weather events.
- Contamination of land and sea ecosystems from disused vehicle waste across the island.
- Greenhouse gas emissions from waste buried and incinerated on-island.
- Long waitlist for social housing.
- Power outages cut cellular reception and payment services (except for satellite phones) isolating the community.
- High reliance on food delivered from the mainland as limited food grown on Masig Island.

Extreme:

- Extreme weather events leading to the island being cut-off from the mainland. This leads to a range of issues including evacuations for health reasons, reduced access to power, water, roads cut to critical infrastructure, telecommunications etc.
- Projected climate change risks include increased temperatures, increased average annual rainfall, increases in the wind speed of tropical cyclones and a decrease in ocean PH (ocean acidification).

KPA	Aspect	Potential Impact(s)	Likelihood	Severity	Risk Evaluation	Current Minimisation/ Mitigation Strategy	Link to Project Option/s
Energy Efficiency, Conservation and Management	**Use of and reliance on fuel**	Depletion of natural energy resources (biomass) through consumption of fuel.	2 – Unlikely	4 - Major	8 – High	Solar array on the island shop and desalination plant, and many houses have hot water systems.	PO 4: Solar PV Rooftop Systems PO 5: Low Emission On-Island Shuttlebus PO 6: Smart Solar Streetlights PO 12: Solar Panels at Sewage Treatment Plant PO 13: Water Supply Energy Efficiency and Solar Project
		Reliance on diesel/ petrol delivery from the mainland which may impact on self-sufficiency/ resilience for Islanders.	3 – Possible	4 - Major	12 – Severe	The airstrip, pilot's house and healthcare centre have back-up generators. Approximately 72 days fuel reserve.	PO 4: Solar PV Rooftop Systems for Housing PO 8: Existing Building Improvements PO 13: Solar Panels at Sewage Treatment Plant
		Potential increase in diesel/ petrol cost to affect energy price causing financial accessibility issues for on-island stakeholders.	5 - Certain	3 - Medium	15 – Severe	No current mitigation strategies observed.	PO 7: Active Transport Options

	Inefficient and outdated equipment	Energy use and costs from inefficient equipment.	4 – Likely	3 - Medium	12 – Severe	Isolated power plant is at capacity. TSIRC has a small-scale program to help residents buy energy and water efficient appliances.	PO 6: Smart Solar Streetlights PO 8: Existing Building Improvements PO 10: Energy Efficient Appliance Upgrades PO 16: Community-led Housing Design Code
Greenhouse Gas Emissions	**Carbon emissions associated with energy use**	Use/ reliance on diesel and motor gasoline contributing to climate change.	4 – Likely	3 – Medium	12 – Severe	There are some solar installations on the island.	PO 4: Solar PV Rooftop Systems for Housing PO 5: Low Emission On-Island Shuttle Bus PO 6: Smart Solar Streetlights PO 7: Active Transport Options PO 16: Community-led Housing Design Code Rec. T4: Alternative fuels for vehicles (land, marine and air)

		Use of non-renewable fuel consumption in transportation to and from the island contributing to climate change.	4 – Likely	3 – Medium	12 – Severe	No current mitigation strategies observed.	Rec. T4: Alternative fuels for vehicles (land, marine and air) Rec. T5: Increase size and capacity of planes to island to reduce trip frequency
		Potential for ozone depleting substances to release gases harmful to human health (e.g. from fridges, air conditioning equipment etc.).	4 – Likely	3 - Medium	12 – Severe	No current mitigating strategies observed.	PO 10: Energy Efficient Appliance Upgrades
	Capacity of renewable energy systems	Renewable energy accounts for a small proportion of total energy generated. Use of diesel generators as back-up during peak loads, increasing greenhouse gas (GHG) emissions.	3 – Possible	3 - Medium	9 – High	No current mitigation strategies observed.	PO 4: Solar PV Rooftop Systems PO 12: Solar Panels at Sewage Treatment Plant PO 13: Water Supply Energy Efficiency and Solar Project

Air Pollution, Noise Control & Light Pollution	**Air pollution**	Vehicle and generator emissions causing air pollution and negatively impacting human health.	1 – Rare	1 – Limited Impact	1 – Low	Emissions from vehicle use would be reduced as the Island is small and the distance travelled is usually no more than 2km. No other current mitigating strategies observed.	
Management of Freshwater Resources	**Water usage**	Reliance on energy for water supply through the two desalination plants creates risks to livelihood and liveability and puts a financial strain on residents.	4 – Likely	4 – Major	16 – Severe	Some rainwater collection. Restoration of Wells project underway to renovate island wells and install pumps creating additional source of non-potable water.	PO 11: Rainwater Harvesting Improvement Program PO 13: Water Supply Energy Efficiency and Solar Project
		Water restrictions for several hours a day for most of the year with potential impacts to human health, particularly in elders and children.	4 – Likely	4 – Major	16 – Severe	Many people purchase bottled water when water sources are restricted, no other current mitigating strategies observed. "24/7" supply water tanks filled with mains water.	PO 11: Rainwater Harvesting Improvement Program PO 18: Community-based Water Demand Management

	Wastewater treatment	Lack of auxiliary power supply at plant leading to risk of failure should the primary power supply fail.	3 – Possible	3 – Medium	9 – High	No current mitigating strategies observed.	PO 4: Solar PV Rooftop Systems for Housing PO 13: Water Supply Energy Efficiency and Solar Project
		Onsite storage and incineration of sludge due to the high cost of transporting this to the mainland which could impact local ecosystems and the community.	4 – Likely	3 – Medium	12 – Severe	No current mitigating strategies observed.	PO 14: Waste Management Optimisation

Land Use Planning and Development	**Coastal vulnerability**	Coastal hazards including cyclones and storm activity causing coastal erosion and damage to infrastructure.	5 – Certain	4 – Major	20 – Extreme	Technical consultancy project underway to identify hazard areas and adaptation plans under the QCoast 2100 Coastal Hazard Adaptation program. Residents have undertaken their own works to reinforce the coastal zone with wooden pallets and palm fronds.	PO 2: Blue Carbon Sequestration Rec. R17: Develop a Masig Island long term vision and plan (resilience, tourism, development planning, fire, land and sea, erosion management) Rec. R19: Jetty design upgrade/replacement to reduce sand accumulation and increase capacity to operate with rising sea levels Rec. R20: Rock wall installation and upgrades Rec. R21: Wind wall installation
Transport	**Island accessibility**	Reliance on external transport providers to bring visitors, workers and residents on and off the island, including evacuations during extreme weather events.	4 – Likely	3 – Medium	12 – Severe	Potential use of personal and fishing boats to travel from Masig to surrounding Islands. No other current mitigating strategies observed.	N/A *Not within project scope*

	On-island transportation	No public transport on the island and transport is predominantly on foot, bike or by car.	5 – Certain	1 – Limited Impact	5 -High	As the island is quite small, public transport options may not be viable unless completely sustainable. No current mitigating strategies observed.	PO 5: Low Emission On-Island Shuttlebus
Solid Waste Management	**Waste storage**	All general waste is stored uncovered at the waste site and presents risks in leaching and contamination of ecosystems.	5 – Certain	4 – Major	20 – Extreme	Green waste is collected and stored separately. General waste is disposed of daily to reduce volume and pests.	PO 14: Waste Management Optimisation PO 15: Island Composting Scheme
		Contamination of land and sea ecosystems from disused and abandoned vehicles across the island.	5 – Certain	3 - Medium	15 – Severe	No current mitigating strategies observed.	PO 5: Low Emission On-Island Shuttlebus PO 7: Active Transport Options PO 14: Waste Management Optimisation

	Waste disposal	Limited waste separation and contamination of waste streams.	4 – Likely	3 – Medium	12 – Severe	Green waste and white goods are stored separately, although contamination is present. Container collection scheme is in operation – SeaSwift program driven by school and students with ranger support.	PO 14: Waste Management Optimisation PO 15: Island Composting Scheme
		High costs associated with removing waste off the island as there is no on-island waste treatment facility.	5 – Certain	2 – Minor	10 – High	No current mitigating strategies observed.	PO 14: Waste Management Optimisation PO 17: Minimise Single-use Plastics and Packaging
		Greenhouse gas emissions from waste stored and incinerated.	5 – Certain	3 - Medium	15 – Severe	No current mitigating strategies observed.	PO 2: Blue Carbon Sequestration PO 14: Waste Management Optimisation PO 15: Island Composting Scheme

Cultural and Social Management	**Unemployment**	Unemployment rates are higher than the national average leading to poor living conditions. High costs of food and fuel exacerbate this.	5 – Certain	2 – Minor	10 – High	The My Pathway Program on Masig Island assists job seekers to develop skills and contribute to their community.	PO 1: Community Market Garden PO 9: On-island Sustainability Officer
	Social Housing	Long waitlist for social housing leading to overcrowding.	5 - Certain	3 – Medium	15 – Severe	No current mitigating strategies observed.	N/A *Not within project scope*
	Island Governance	Environmental management and values are intrinsic to the island's governance. However, there is a risk of losing traditional knowledge and ways of life through requirements of a modern lifestyle. This presents a risk to human health (mental) and to the ability of the governance systems to manage environmental risks.	3 – Possible	3 - Medium	9 – High	Elders are identifying opportunities to share knowledge with younger generations (e.g. boat building project). The seasonal calendar also helps to convey this knowledge. Many previous pilot projects on the island to assist Islanders in becoming more sustainable (TSRA, PBC).	PO 3: Community-led Traditional Knowledge Sharing and Education PO 9: On-island Sustainability Officer PO 16: Community Led Housing Design Code

Economic Management	**Social and economic viability**	High cost of insurance premiums in North Queensland increases cost of business impacting returns or means that insurance is unaffordable, and assets are uninsured, leading to greater vulnerability during extreme weather events.	5 – Certain	2 – Minor	10 – High	Insurance resilience programs are improving properties to reduce future claims. QRA leading disaster resilience programs.	N/A *Not within project scope*
		Power outages cut cellular reception and payment services (except for satellite phones) isolating the community.	3 – Possible	4 – Major	12 – Severe	No current mitigating strategies observed.	Rec. R16: Additional communication systems (emergency, internet, GPS, mobile communication)
		High cost of energy and water reduces business returns and investment.	3 – Possible	1 – Minor	3 – Medium	No current mitigating strategies observed.	

Resilience	**Severe weather events**	Extreme weather events leading to the island being cut-off from the mainland. This leads to a range of issues including evacuations for health reasons, reduced access to power, water, roads cut to critical infrastructure, telecommunications, etc.	4 – Likely	5 - Catastrophic	20 – Extreme	No current mitigating strategies observed.	PO 1: Community Market Garden PO 4: Solar PV Rooftop Systems for Housing PO 11: Rainwater Harvesting Program PO 13: Water Supply Energy Efficiency and Solar Project Rec. R16: Additional communication systems
	Food availability	High reliance on food delivered from the mainland as limited food grown on Masig Island. High cost of food through the supermarket.	4 – Likely	3 – Medium	12 – Severe	Although there are a small number of backyard gardens, there are no current mitigation strategies in place.	PO 1: Community Market Garden

	Climate change	Projected climate change risks include increased temperatures, increased average annual rainfall, increases in the wind speed of tropical cyclones and a decrease in ocean PH (ocean acidification). These changes reduce the community's adaptive capacity (ability to adjust to change).	4 – Likely	5 – Catastrophic	20 – Extreme	Multiple studies to solidify understanding of the situation. No current mitigating strategies observed	PO 3: Community-led Traditional Knowledge Sharing and Education Rec. R17: Develop a Masig Island long term vision and plan (resilience, tourism, development planning, fire, land and sea, erosion management)
		The flat topography of Masig Island makes it extremely vulnerable to sea level rises.	4 – Likely	5 – Catastrophic	20 – Extreme	Complaint against the Australian Government to the UN Human Rights Commission has increased awareness of their issues.	Rec. R20: Rock wall installation and upgrades Rec. R21: Wind wall installation
		High cost to defend and protect coastal areas and infrastructure leading to allocation of funds to high risk areas (not all assets/ areas can be protected).	3 – Possible	5 – Catastrophic	15 – Severe	Technical consultancy project underway to identify hazard areas and adaptation plans under the QCoast 2100 Coastal Hazard Adaptation program.	PO 2: Blue Carbon Sequestration PO 9: On-island Sustainability Officer Rec. R20: Rock wall installation and upgrades Rec. R21: Wind wall installation