



The Moreton Bay
Foundation



Living and Playing Together: Digital Platform Development

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In collaboration with

University of Queensland | Reef Check Australia | Maritime Safety Queensland | University of the Sunshine Coast



Living and Playing Together: Digital Platform Development

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Table of Contents

Acknowledgements.....	3
1. Introduction	5
2. Data Overview.....	6
2.1. Included Data Collections	6
2.2. Data Processing.....	7
2.3. Data Storage.....	7
2.4. Platform Imagery.....	7
3. Boat Detections from Satellite Imagery	9
3.1. Data Overview.....	9
3.2. Method Overview	10
3.3. Preliminary Results.....	12
4. Living and Playing Together Digital Platform.....	14
4.1. Story Mode.....	15
4.2. Data Mode	16
5. Conclusion.....	18
Appendix A.....	20
Appendix B	25

1. Introduction

Quandamooka Country, nestled within the Moreton Bay Marine Park, is a region of exceptional ecological, cultural, and recreational significance. Spanning diverse ecosystems from coastal habitats to intricate underwater landscapes, this area is a living testament to the rich biodiversity that thrives in Southeast Queensland. The Quandamooka people, the traditional custodians of these lands and waters, hold a profound connection to this country, maintaining their cultural practices and knowledge through generations. This cultural landscape is marked by sacred sites, traditional practices, and a deep-rooted connection to the land and sea, making it an invaluable repository of cultural heritage.

Quandamooka Country overlaps significantly with the Moreton Bay Marine Park (MBMP), a region designated by the Queensland Parks and Wildlife Services (QPWS) for conservation purposes. The MBMP is a biodiversity hotspot, home to an array of marine life, including endangered species such as dugongs, turtles, dolphins, and various fish species. This marine park plays a vital role in supporting the ecological balance of the region through its diverse habitats, including seagrass beds, coral reefs, and mangroves. These habitats not only support a wide range of marine animals but also provide crucial ecosystem services. Seagrass beds and filter-feeding organisms offer water filtration to support marine life, mangroves reduce coastal erosion, and mangroves, seagrass beds, and saltmarshes sequester carbon to contribute to climate regulation.

The “Living and Playing Together” project offers a digital showcase of Moreton Bay through diverse data collections captured in the region to support education, awareness, and sustainable management of the Bay. It aims to empower people with better knowledge of the extraordinary environment, biodiversity, and recreational activities in the area. Fostering a shared understanding of the use of Moreton Bay by both wildlife and people, the project aims to promote sustainable practices that ensure the long-term health and enjoyment of this unique region. In the face of growing environmental challenges and the anticipated increase in recreational use due to events like the 2032 Olympic Games, this project supports key decision-makers and the wider public to take coordinated action by bringing many sources of information together in one location. Funded by the Moreton Bay Foundation, the project was conducted between 2022 and 2024 by Queensland University of Technology and its partners. This report provides a summary of the collaborators, the data assets acquired for the project, and design aspects of the Living and Playing Together Platform.

This report summarises the data explored and collected throughout the project and provides an overview of the Living and Playing Together digital platform, developed by Queensland University of Technology’s Visualisation and Interactive Solutions for Engagement and Research (VISER) group. This work was funded by the Moreton Bay Foundation and the SmartSat Cooperative Research Centre and was carried out between mid-2022 and mid-2024, with contributions from multiple research and community partners, including University of Queensland, Reef Check Australia, Maritime Safety Queensland, and University of the Sunshine Coast. The remainder of this report provides an overview of the data collections used (Section 2), the methodology and results of automated boat detection (Section 3), and the design and functionality of the platform itself (Section 4), concluding with reflections and recommendations (Section 5).

2. Project Methods and Data Overview

This section outlines the project's overarching data methodology, which consisted of three phases: (1) identification and review of available data assets relevant to the Moreton Bay Marine Park; (2) acquisition and processing of selected datasets to ensure consistency and integration across formats and spatial references; and (3) implementation of specific data pipelines to derive new insights, such as the boat detection algorithm described in Section 3. These methods underpin the development of the Living and Playing Together platform and reflect a deliberate effort to combine ecological, recreational, and spatial datasets into a unified interface.

During the early stages of the project (mid-late 2022) the data team conducted a survey of available data in the Moreton Bay region that captured different aspects of the environment, biodiversity, and recreational activities. In October 2022, results of this survey were presented to the project's Advisory Committee and were further refined in 2023 and during the platform review phase in 2024. During late-stage developments, the data and platform teams considered the addition of tourism and Census data to describe the populations most-likely to use the marine park. However, it was ultimately decided that data should be restricted to those on or in the waters of Moreton Bay for this iteration of the Living and Playing Together platform.

2.1. Included Data Collections

The Living and Playing Together platform incorporates a diverse array of data collections that capture the multifaceted nature of Moreton Bay's environment, biodiversity, and human activities. These datasets range from ecological surveys and social value assessments to advanced geospatial data, each contributing uniquely to the comprehensive understanding of the region.

The data survey was conducted from January to June of 2023 and involved a review of publicly available spatial and ecological datasets, published research outputs, and data from partner organisations. Sources included Queensland Government open data portals, the Australian Ocean Data Network (AODN), university research repositories, and citizen science platforms such as Reef Check. Datasets were assessed based on (a) relevance to the Moreton Bay Marine Park, (b) spatial coverage within or adjacent to the Bay, (c) data quality and resolution, (d) potential for visualisation or integration into the platform, and (e) data accessibility. Preference was given to datasets with accompanying metadata, regular update cycles, or known custodianship.

Ecological datasets, such as the 360-degree imagery provided by Underwater Earth and the University of Queensland, and the 3D interactive photomosaics from the Sustainable Urban Seascapes project, offer detailed visual representations of the marine environment. These images help illustrate the intricate ecosystems within Moreton Bay, including coral reefs, seagrass beds, and benthic habitats, allowing users to explore the underwater world in a highly immersive manner. Additionally, the fish and invertebrate abundance surveys conducted by Reef Check Australia provide critical data on species diversity and population trends over time, essential for monitoring and conservation efforts.

Social and recreational data, like the Moreton Bay Social Values Survey conducted by the University of Queensland, capture the human dimension of Moreton Bay, documenting the activities, preferences, and values of visitors to the marine park. This information is vital for understanding how people interact with the environment and for informing sustainable management practices. Similarly, the boat detection data from the Queensland University of Technology's Centre for Data Science uses machine learning to map recreational and commercial boating activity, offering insights into human usage patterns and potential impacts on marine ecosystems. This boating activity data asset was created for use in the Living and Playing Together platform, with more detail provided in Section 3.

Geospatial datasets form the backbone of the platform, with high-resolution satellite imagery from the Allen Coral Atlas and Mapbox providing comprehensive coverage of the region. These layers, combined with detailed maps of wetland extents, shipping channels, and designated marine park zones, enable users to better understand some of the complex, dynamic systems that exist in Moreton Bay. The consistent use of the EPSG:4326 Coordinate Reference System ensures that all datasets are seamlessly integrated, enabling users to toggle between different data layers effortlessly.

Together, these diverse data collections create a holistic view of Moreton Bay, highlighting the interplay between natural habitats, wildlife, and human activities. By bringing these datasets into a single platform, Living and Playing Together fosters a deeper understanding and appreciation of the region, supporting informed decision-making and promoting sustainable practices. A comprehensive list of included data assets can be found in Appendix A.

Additionally, a small number of data assets were identified and/or accessed throughout the project but were ultimately not presented in the platform because of one or more of (a) approvals, (b) processing requirements, (c) visualisation difficulties, (d) scope limitations, or (e) time constraints. Examples of such assets include population and housing Census data from the Australian Bureau of Statistics, boat registrations from Maritime Safety Queensland, marine observations from iNaturalist and from the Moreton Bay Environmental Education Centre, aerial dugong surveys from James Cook University, and water quality measurements from Brisbane City Council.

2.2. Data Processing

Data cleaning and preparation for the Living and Playing Together project involved merging and separating certain spatial data assets, removing extraneous information, and reformatting data where necessary for integration into the platform. Certain data required simple transformations from long to wide formats and others required additional processing to support visualisations. For example, a UQ survey exploring social values in Moreton Bay required additional processing to extract each survey site's most-valued social aspect to allow for colour coding of sites in the platform.

Quality assurance was a critical component of our data processing workflow. Prepared data were reviewed during frequent data team meetings, and each data asset was further scrutinized during its integration into the platform. For consistency, all geospatial data were projected using the EPSG:4326 Coordinate Reference Systems (CRS). This standardisation facilitated the integration of these different types of data into a unified SQL database, enabling seamless toggling of layers in the final product.

2.3. Data Storage

The data is currently stored on the Queensland University of Technology's Research Data Storage Service (RDSS). This facility provides long-term storage solutions for researchers, ensuring that the data is secure and accessible for future use. The RDSS employs robust access and security measures, including controlled access permissions and regular backups, to protect the data. These measures ensure that only authorized personnel have access to the raw data and ensure that these data assets are not incidentally made publicly available through the platform.

While the current platform is internally developed at QUT, future iterations may involve external ownership, necessitating data migration. The transition to external platforms will include careful planning to maintain data integrity and continuity of access to relevant project personnel.

2.4. Platform Imagery

The Living and Playing Together platform leverages a rich collection of photography to support the narratives in the platform's story mode, helping to create a vivid connection between readers and the

environment and biodiversity of the Moreton Bay region. Photography included in the platform has been provided by:

- Chris Roelfsema, University of Queensland
- Frankie Cho, University of Queensland
- Gerard Davis
- Pete's Fishing and Underwater Videos (via Healthy Land and Water)
- Sonja Nieuwoudt (via Healthy Land and Water)
- Gemma MacKenzie (via Healthy Land and Water)
- Nik Michail, Sustainable Dreaming
- Doug Fielding, Regatta Maritime

Each photograph is credited individually as they appear in the platform.

3. Boat Detections from Satellite Imagery

Moreton Bay covers almost 5000 square kilometres of land and sea and is both a popular recreational area for locals and tourists, as well as a having a rich ecosystem of marine life. As such, understanding and reacting to boat usage through marine park zoning and monitoring is vital not only for safety purposes, but also for conservation of the natural area.

With hundreds of boats exploring the area each day, manual counts are infeasible to conduct at regular intervals. While commercial boats are required to be equipped with GPS, many recreational vessels are not and so cannot reliably be monitored this way. To improve management practices in the Bay, we have developed a machine learning approach to automatically detect the location of boats in the Moreton Bay Marine Park each day. Satellite imagery is not a complete solution for monitoring boat locations, as (a) satellite imagery can be expensive, especially high-resolution imagery, (b) cloud cover inhibits visibility regularly, and (c) imagery is not constantly or consistently captured as satellite orbits do not typically align with the Earth's night-day cycle. Instead, boats detected through this activity indicate patterns in boating activity that could then be used to determine changes over time, across seasons, etc.

3.1. Data Overview

For this project, satellite images were obtained through Planet Labs using an Education and Research License (free to research institutions), which allows the collection of up to 5,000km² of 3m resolution satellite imagery per month, with images obtained from the PlanetScope satellite. To optimise use of the image quota, this project classified boats in three key areas around Moreton Bay: Peel Island and surrounds, South Bribie Island, and the Tangalooma wrecks. These three regions are shown in Figure 1, below.

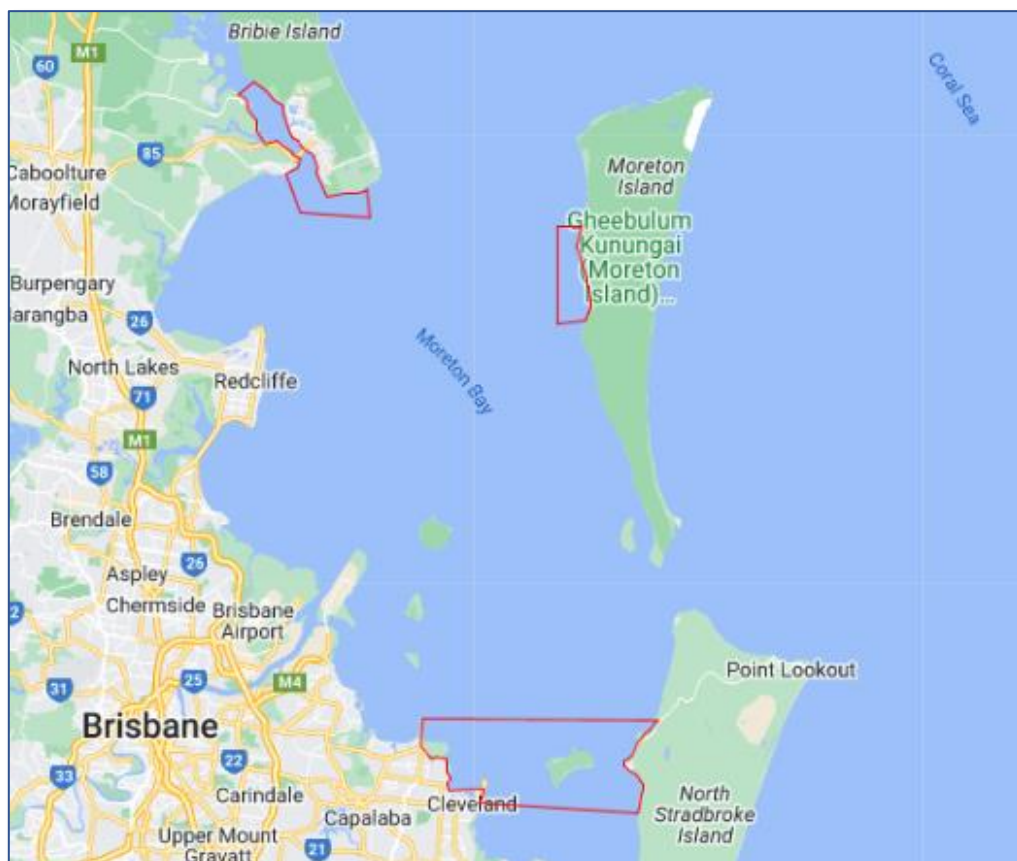


Figure 1: Case study areas for automated boat detection.

These areas were selected during a stakeholder workshop, held in Q4 2022, and were chosen because they represent a diverse range of recreational and ecological contexts within the Bay. Peel Island is a popular boating and mooring location with sensitive marine habitats; South Bribie Island is a sheltered area frequently used for launching and anchoring vessels; and the Tangalooma wrecks are an iconic artificial reef site with high tourism and snorkelling activity. Together, these regions provide representative coverage of different types of human and environment interactions across Moreton Bay and allow for comparison of boating activity patterns across varied marine zones.

To account for inconsistent coverage over time (caused by a combination of satellite overpass schedules and frequent cloud cover obscuring the case study areas), we instead aimed to compile case study area activity twice per week: once during weekdays and once during the weekend, subject to the following thresholds.

1. Imagery must cover at least 95% of the area of interest.
2. Imagery must have less than 10% cloud coverage.

When both thresholds are used while obtaining images from Planet Labs, the temporal resolution decreases significantly enough that some weeks and months have no images that comply with these thresholds. During the collection period the data team noted that the satellite imagery is most commonly captured at 9am AEST. A sample of PlanetScope imagery is provided below in Figure 2.

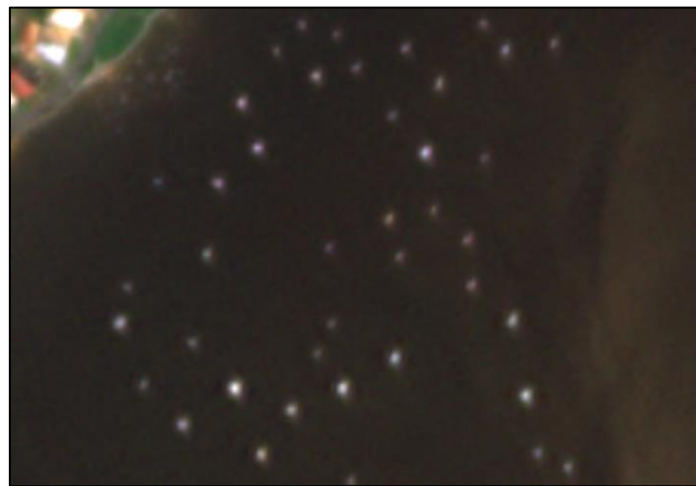


Figure 2: Planet Labs' PlanetScope satellite imagery sample (3m resolution).

3.2. Method Overview

Data accessed from Planet Labs used to automatically detect boats by employing machine learning methods. To achieve this, boats are manually classified from a wide range of satellite images to determine the location of stationary and moving boats. In this project, this was achieved using open-source software, LabelMe (see examples below in Figure 3 and Figure 4).

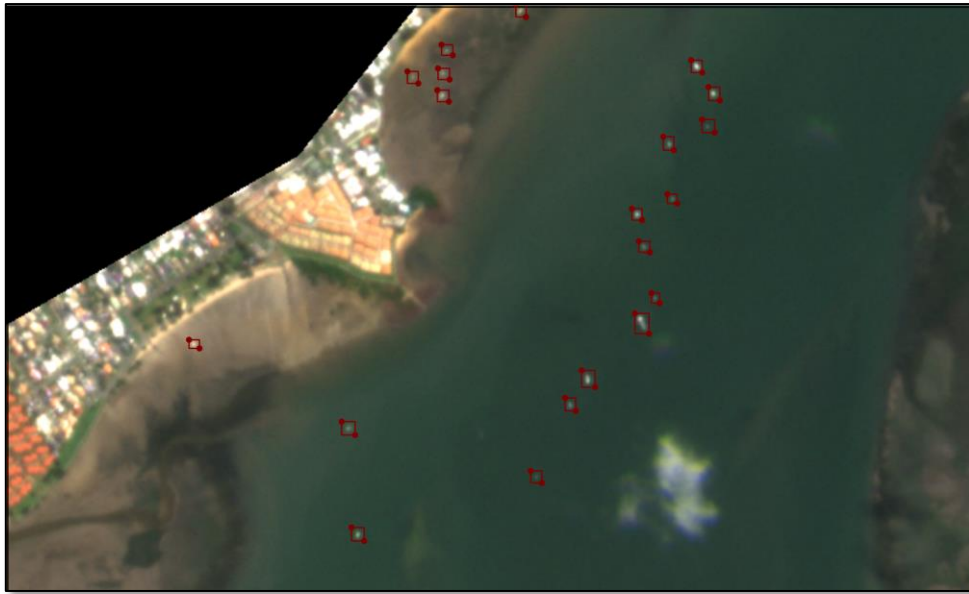


Figure 3: Examples of stationary boat annotations.



Figure 4: Examples of moving boat annotations.

These manual classifications are compiled into text documents and are fed into a neural network alongside the associate satellite imagery to train the network to better understand the pixel patterns in imagery and when certain patterns should be determined as a stationary or moving boat. This process involves splitting, padding, and overlapping images to assist with processing and detection performance, though details of these steps are omitted here. Once the training step is completed, we employ the model on never-before-seen imagery to develop a time-series database of boat locations in Moreton Bay (see data structure in Table 1, below).

Table 1: Output data structure from the automated detection pipeline.

Field	Description
Date	The date on which the image was taken. Format: DD/MM/YYYY
Latitude	Latitude of boat detection
Longitude	Longitude of boat detection
Class	0: Stationary Boat, 1: Moving Boat
Confidence	[0-1]: Confidence of detection as provided by YoloV5

Boat location data presented in the Living and Playing Together platform takes boat detections from our model which have confidence above 50% (see sample detections in Figure 5). The neural network

accuracy can only be measured in comparison to known or “ground-truth” data. For boat classification, known data is any satellite image that has been manually labelled by a human. On unseen images, testing revealed a detection accuracy of almost 93% (from a sample of 11 images, see Figure 6).



Figure 5: Sample of automated detections.

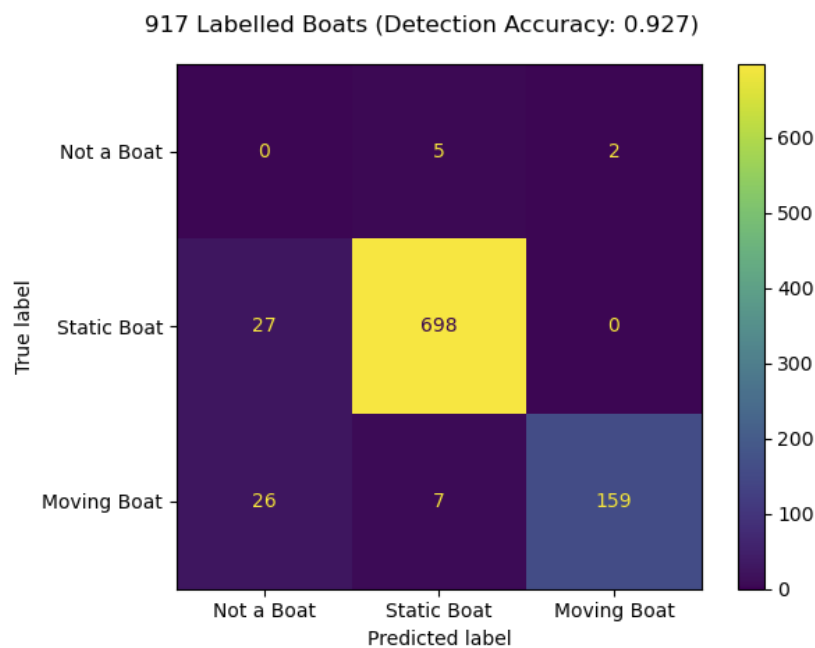


Figure 6: Confusion matrix noting detection accuracy for stationary and moving boats across 11 sample images, taken around the Moreton Bay Marine Park. Note that the 0 in the top-left is to be expected: absences of a boat are not labelled or detected specifically, with the ‘Not a Boat’ category being for when a boat was labelled or detected, but not both.

3.3. Preliminary Results

This boat detection data set has been created as part of the Living and Playing Together platform to help users better understand how humans use the Moreton Bay Marine Park. As such, these data have not been utilised to determine any patterns in activity according to weekdays, weekends, seasons, etc. The following figures capture aspects of boating activity and satellite image availability.

Living and Playing Together



Figure 7: All boat classifications in the "Peel Island and surrounds" case study area from Jan 2016 to Feb 2023.

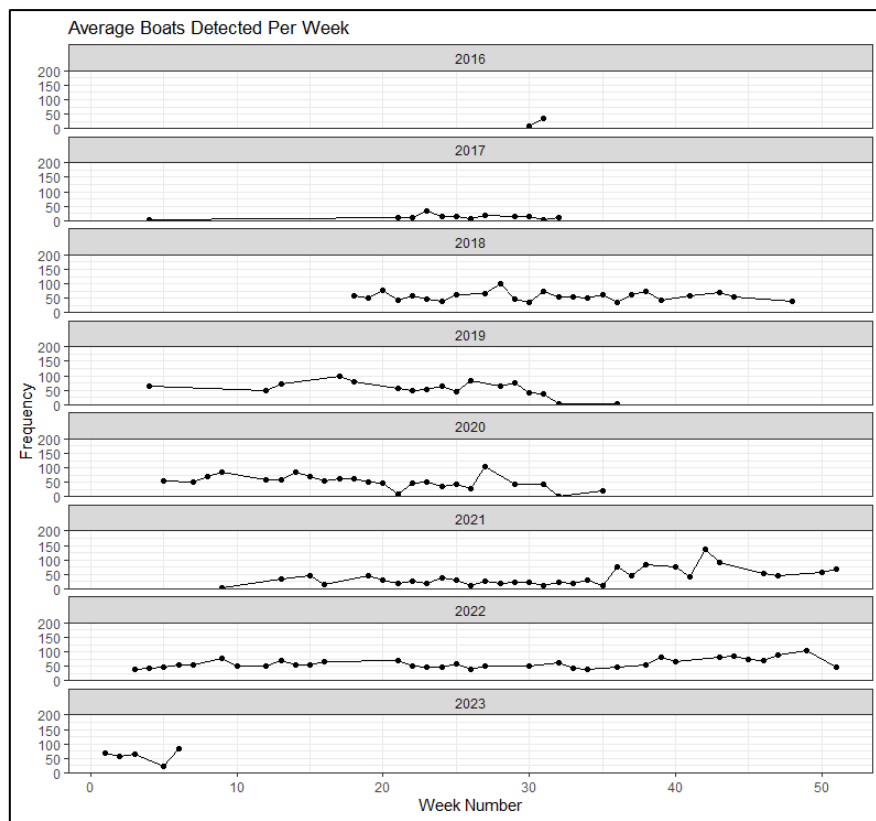


Figure 8: Average number of boats classified in the "Peel Island and surrounds" case study area.

Living and Playing Together

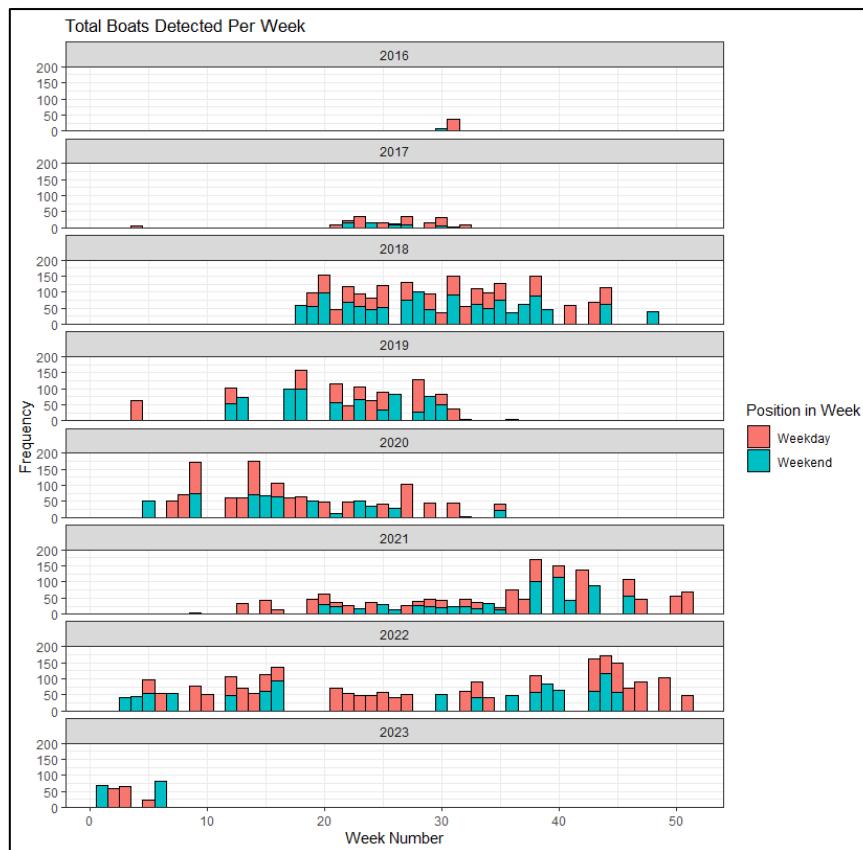


Figure 9: Week-to-week total boat counts in the "Peel Island and surrounds" case study area.

4. Living and Playing Together Digital Platform

The Living and Playing Together platform (available at <https://livingplayingmoretonbay.myglobe.app>) has been developed by Queensland University of Technology's Visualisation and Interactive Solutions for Engagement and Research (VISER) group using Mapbox, which provides a comprehensive suite of tools for creating custom spatial applications. The Living and Playing Together project contains a diverse array of data types, including acoustic data, 3D scans of the sea floor, boating activities over time, 360-degree photos and videos, and survey data capturing social values of Moreton Bay. VISER has taken great care to produce a digital platform that gathers these data types together and simultaneously presenting that data in a way that is educational and inspirational rather than overwhelming. To gently guide users to explore the different types of data shown in the platform, VISER adopted a storytelling approach that supports user engagement, while pairing these stories with a view of a map interface which evolves as users progress through the content. This "scrollytelling" interface directs users through diverse data in themed chunks that are contextualised by the provided narratives. This is all implemented using a content management system that manages the presentation and interaction of spatial layers, camera movements, and automatic pop-up interactions, allowing sections of the stories to trigger specific actions on the map interface.

The VISER team also created a content management system to handle the collation and mixing of Mapbox styles and uploaded tilesets, along with the dynamic styling of these tilesets, to create a seamless environment when mapping elements are modified as the user interacts with the platform. VISER also created custom tilesets from existing files to support detailed low-level zoom functionality, maintaining the user experience when zooming in to explore fine data in the platform. Initially, a

timeline feature was considered to support various time-series data assets; however, this functionality was simplified to apply only to boat location data to streamline the interface.

To support the platform's goals of enabling users to freely explore data throughout the Moreton Bay Marine Park while also creating a narrative-focused approach to engage and educate, the Living and Playing Together platform was designed as a dual-mode platform. The platform's "data mode" allows users to toggle layers on or off as desired for user exploration, while the "story mode" guides users through different aspects of the Bay by displaying data layers on a map alongside engaging narratives.

4.1. Story Mode

The platform's story mode is displayed in Figure 10 and shows the list of stories for quick navigation alongside both the first story, "Living and Playing Together in Moreton Bay", and the interactive map.

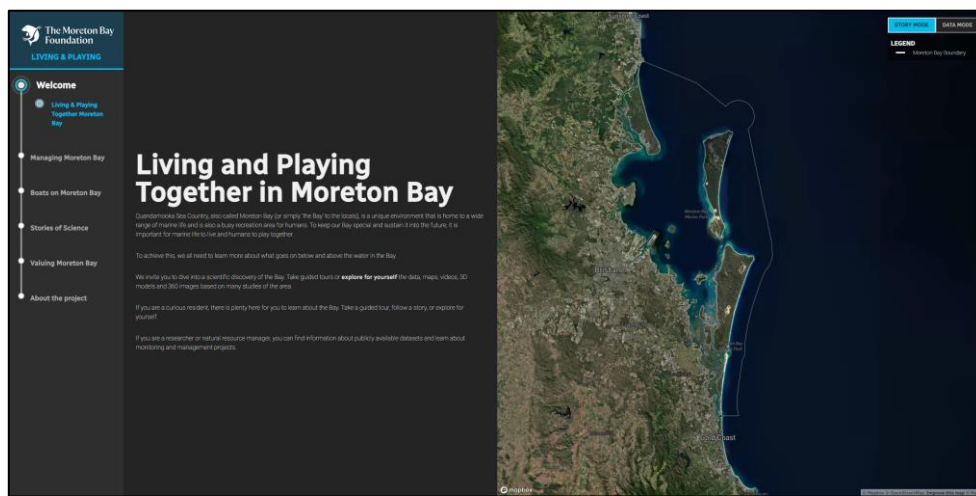


Figure 10: Initial view of the Living and Playing Together platform's story mode.

As the user scrolls through the platform, data assets related to the stories become active and the legend changes to describe the new features being shown. As the stories change, the interface pans, zooms, and tilts to highlight relevant data, with features remaining active so that users can interact at will with the scenes as they read through the stories. Examples of interactive features, such as data summaries and interfaces to explore 360-degree imagery, are shown in Figure 11.

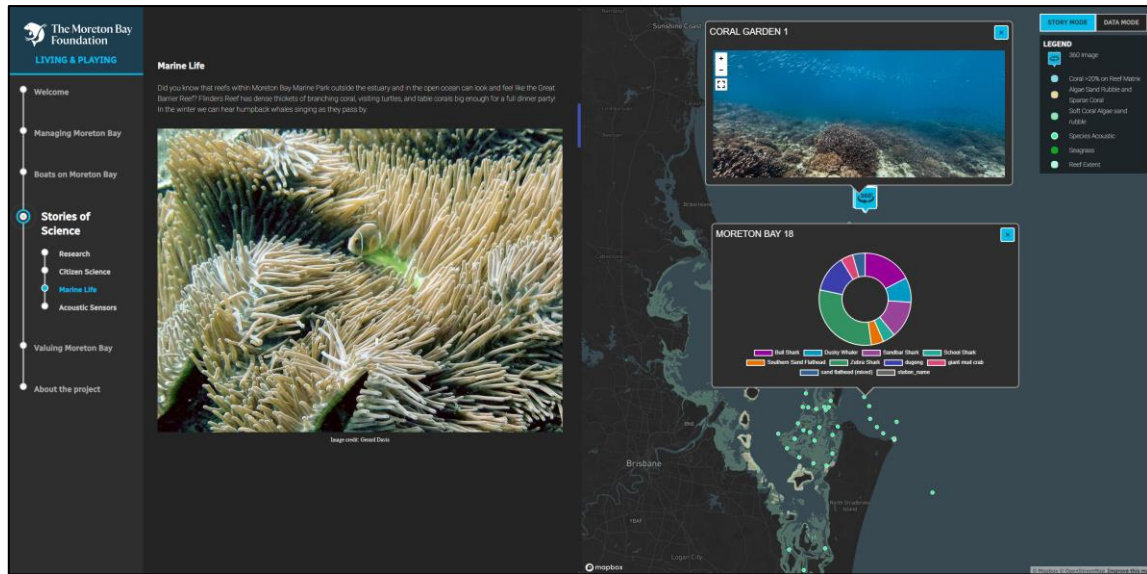


Figure 11: Snapshot of the "Marine Life" story in the platform's story mode. Note the interactive map elements used to explore both 360-degree imagery from Underwater Earth (University of Queensland) and acoustic telemetry data from the Australian Ocean Data Network.

The full set of stories included in the platform's story mode is provided in Appendix A.

4.2. Data Mode

The platform's data mode is shown in Figure 12 and displays the Moreton Bay region alongside all data assets available for visualisation in the platform.

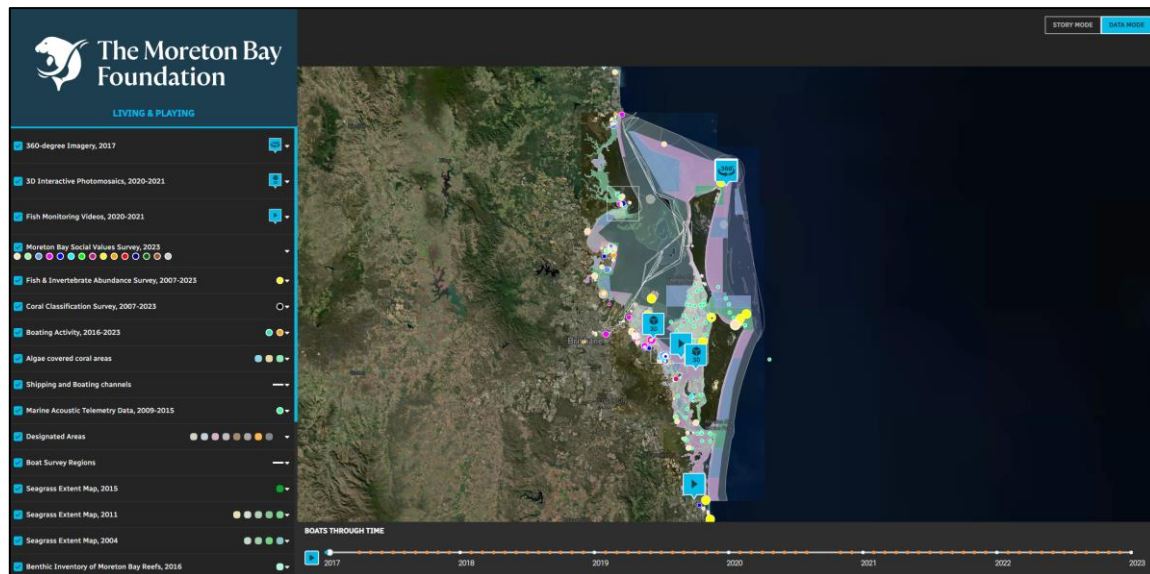


Figure 12: Initial view of the Living and Playing Together platform's data mode.

Rather than displaying a legend on the map, colours are provided alongside each data asset that can be referred to at-a-glance. This mode allows users to pan, zoom, and tilt the map interface. Users can also modify opacity settings for relevant data assets and interact with a timeline when boat activity data is enabled.

The data mode of the Living and Playing Together digital platform is designed to empower users with the ability to explore and interact with a wide range of data related to Moreton Bay. By presenting data

Living and Playing Together

in toggleable layers, users can delve into specific aspects of the bay's biodiversity, environmental conditions, and human activities outside of the pre-set story experience. The following figures show how the data mode may be used.

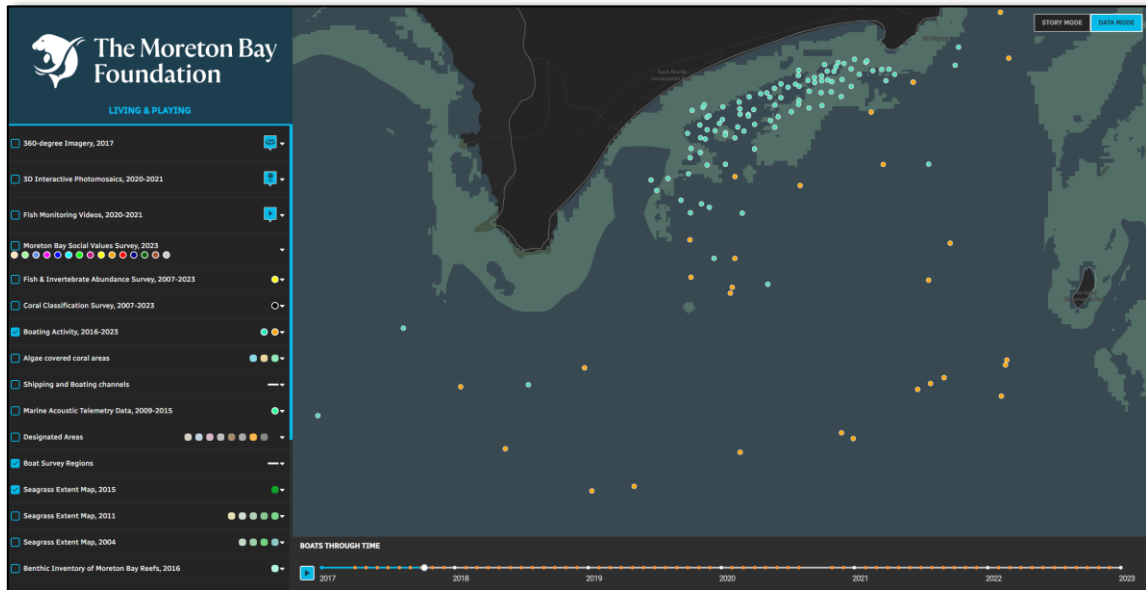


Figure 13: Potential interaction between boating activity (2017 data) and seagrass extent (2015 data), south of Peel Island.



Figure 14: Non-compliance with designated zones near Dunwich, 2021.

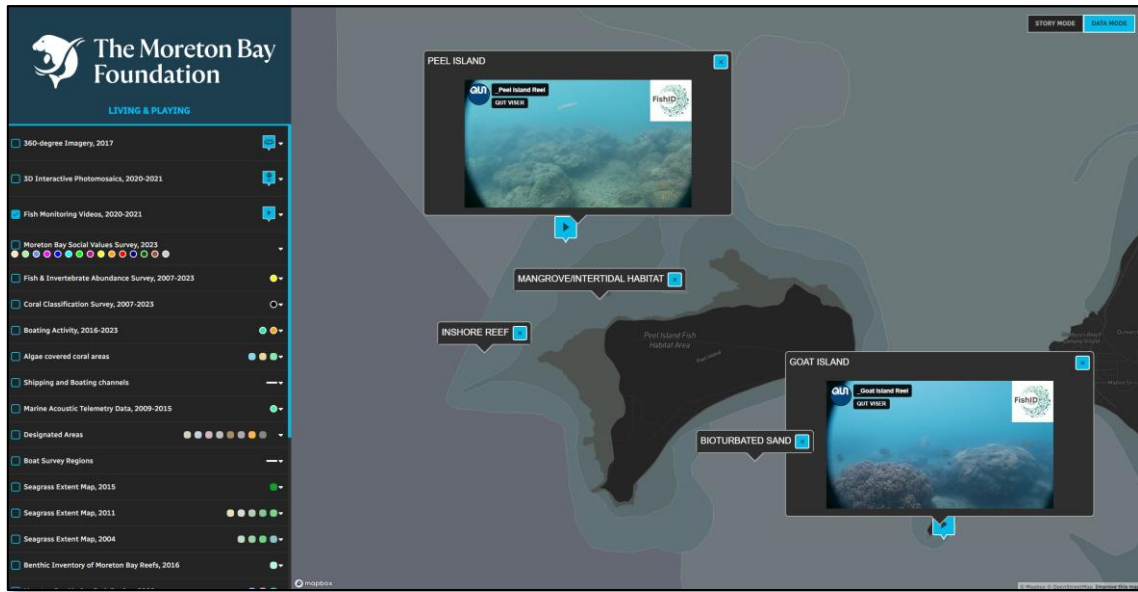


Figure 15: Exploring Peel Island using declared habitat zones and fish monitoring videos.

5. Conclusion

The primary objective of the Living and Playing Together digital platform is to empower local communities, stakeholders, and visitors with better knowledge of the marine environment and recreational use of Moreton Bay. The combination of comprehensive data sets, an accessible and engaging interface, and collaboration with key actors in the Moreton Bay conservation space establishes the platform as an enabler for public engagement with the potential in future to act as a knowledge and/or data hub that can be used to improve management practices and drive long-term conservation impacts.

We acknowledge, however, that the platform in its current form reflects the perspectives and priorities of environmental and data science disciplines. While it draws on high-quality data and storytelling techniques, its ability to engage the broader public (particularly those without pre-existing interest in marine science) is limited. Future iterations should include stronger interdisciplinary collaboration with humanities, arts, and social sciences to broaden relevance and resonance across diverse audiences.

We also recognise that references to Quandamooka Country and custodianship, while well-intentioned, do not substitute for genuine representation of First Nations stories, voices, and perspectives. Future work must engage meaningfully with Traditional Custodians and community Elders to ensure cultural knowledge is respectfully and appropriately shared and that these processes are guided by those communities themselves.

As is common in pilot projects, this iteration of Living and Playing Together establishes capability as a multi-faceted tool capable of presenting diverse data with an engaging user interface and paired educational material. We acknowledge that platform accessibility, user interface, colours, etc. may need revisions in future to enhance user experience and these changes will be considered in future as resources allow for further development of the platform.

With the pilot demonstrated, the stage is set to gather more data from a broader network of government initiatives and research institutions to create an even more comprehensive view of the interactions between humans and the Moreton Bay Marine Park.

As Brisbane continues to develop and grow in population, alongside increasing tourism demands, it is crucial for both the public and new residents to understand the immense value of Moreton Bay. The upcoming 2032 Olympics will significantly impact the use of this region, highlighting the need for a resource that brings together information and presents it in a way that fosters a deep appreciation for Moreton Bay. By bringing together research, data, and citizen science efforts, the Living and Playing Together digital platform aims to support ongoing and future conservation and education initiatives. This platform is not only a tool for current stakeholders but also a vital resource for future inhabitants in and around Moreton Bay to ensure the long-term sustainability and enjoyment of the region.

Appendix A

Living and Playing Together Data Summaries

Formal Name	Citation	Description
360-degree Imagery, 2017	Underwater Earth, University of Queensland (https://www.underwater.earth/oosoo-mind)	Imagery provided by Underwater Earth, a not-for-profit founded to inspire problem-solving to address our ocean's problems through creative storytelling using innovative technology. In partnership with the University of Queensland, these 360-degree images were taken as part of the Flinders Reef Ecological Assessment (FREA) project, which aimed to conduct an ecological assessment and mapping of Flinders Reef marine environment using a community based, cost effective, scientifically sound survey program.
3D Interactive Photomosaics, 2020-2021	Sustainable Urban Seascapes Moreton Bay, University of Queensland (https://marine.uq.edu.au/article/2023/03/leveraging-partnerships-sustainable-management-urban-seascapes)	A series of 3D photomosaics across the Moreton Bay Marine Park, created by a research student at University of Queensland as part of a Sustainable Urban Seascape (Moreton Bay) project. These photomosaics are created using photogrammetric sampling along case study transects at different sites throughout 2021 and 2022.
Fish Monitoring Videos, 2020-2021	Moreton Bay Live project, Coastal and Marine Research Centre, Griffith University (https://www.griffith.edu.au/coastal-marine-research-centre/researchers)	This data set is comprised of videos in the Moreton Bay Marine Park supplied by the Global Wetlands Project (https://globalwetlandsproject.org/moreton-bay-live/) in collaboration with the Griffith University Coastal Marine Research Centre (https://www.griffith.edu.au/coastal-marine-research-centre/researchers). The videos capture different kinds of marine activity, including demonstration of predation encounters, videos showing changes in abundance for different species of fish, and demonstrations of the Global Wetlands Project's automated fish tracking capabilities.
Moreton Bay Social Values Survey, 2023	University of Queensland (https://storymaps.arcgis.com/stories/5ea4883393dc47a0a17e96d652e6a8ab)	Survey data collected by the University of Queensland to better understand how the Moreton Bay Marine Park is valued by users. For each location in the survey, respondents were asked what activities they conduct there, the frequency they visit, and why they visit under a social values framework. Respondents were also asked to assign a total of 100 points between values based on how important each survey site was to them.

Fish & Invertebrate Abundance Survey, 2007-2023	Reef Check Australia (https://www.reefcheckaustraliadata.org)	Fish and invertebrate abundance survey data from 2007-2023 provided by Reef Check Australia. This survey data covers a range of sites within the Moreton Bay Marine Park and lists a range of fish and invertebrates observed during the survey, including barramundi, groupers, sea urchins, crown-of-thorns starfish, and anemone.
Coral Classification Survey, 2007-2023	Reef Check Australia (https://www.reefcheckaustraliadata.org)	Coral classification survey data from 2007-2023 provided by Reef Check Australia. This survey data covers a range of sites within the Moreton Bay Marine Park and lists a range of corals identified during the survey, including hard corals, soft corals, and recently killed corals as well as other classification categories such as sponges and rubble.
Boating Activity, 2016-2023	Centre for Data Science, Queensland University of Technology (https://www.qut.edu.au/research/centre-for-data-science)	Boat detection data collected by the Queensland University of Technology's Centre for Data Science. The data set is comprised of moving and stationary boats (of length between roughly 3-30m) across three case study areas in the Moreton Bay Marine Park: south Bribie Island, the Tangalooma wrecks, and Peel Island. These data were captured via machine learning, using two satellite images per week (one weekday and one weekend image, subject to availability and weather) from July 2016 to February 2023.
Benthic Inventory of Moreton Bay Reefs, 2016	Remote Sensing Research Centre, University of Queensland (https://doi.pangaea.de/10.1594/PANGAEA.892402)	Benthic inventory of reefal areas in Moreton Bay, Australia. The inventories for each reefal area were based on georeferenced spot check field data collected by volunteer teams in 2015 and 2016, overlaid on high-resolution satellite imagery captured in 2014. Areas were then assigned a category based on interpretation of texture and colour of the pixels in the satellite imagery. This dataset is the product of a collaborative citizen science project between Reef Check Australia, The University of Queensland Remote Sensing Research Centre and Healthy Waterways to collect benthic inventories for eight key subtropical reefal areas in Central Moreton Bay - Mud, Saint Helena, Green, King, Macleay, Goat, and Peel Islands, and, Myora Reef.
Wetland Extent Classifications, 2019	Wetlands Team, Queensland Department of Environment, Science, and Innovation (https://wetlandinfo.des.qld.gov.au/wetlands/about-us/)	This data set contains spatial information on wetland extent and type e.g., lacustrine, estuarine, palustrine in and adjacent to the Moreton Bay Marine Park.

Shipping and Boating Channels	Port Procedures and Information for Shipping, Port of Brisbane (https://www.publications.qld.gov.au/dataset/brisbane-port-procedures-and-information-for-shipping/resource/55e36402-ea28-499f-a46e-93368765337e)	This data set contains shipping channels produced by the Port of Brisbane in 2018.
Marine Acoustic Telemetry Data, 2009-2015	Australian Animal Acoustic Telemetry Database, Australian Ocean Data Network (https://portal.aodn.org.au/search)	This data was sourced from the Australian Ocean Data Network (https://animaltracking.aodn.org.au/) and contains marine acoustic detections associated with created and deployed transmitters throughout the Moreton Bay Marine Park from December 2009 through to October 2015. The data set contains over 100,000 detections of various species, including Australian bass, sandbar sharks, giant shovelnose rays, dugongs, and giant mud crabs. This data is a compilation of numerous projects conducted as part of the AODN and with connections to the Australian Institute of Marine Science (AIMS) and the Integrated Marine Observing System (IMOS).
Moreton Bay Marine Park Designated Areas, 2008	Queensland Parks and Wildlife Service and Partnerships, Department of Environment, Science, and Innovation (https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={65300831-53D8-477F-A408-C5835FCF06B0})	This data set contains the Moreton Bay Marine Park 2008 designated areas, created by the Queensland Department of Environment, Science, and Innovation. These designated areas include go slow areas for natural values and for turtle and dugong protection, mooring areas for boats, and no-anchoring areas for the protection of coral habitats.
Seagrass Extent Map, 2015	Moreton Bay Research Station, University of Queensland (https://www.uq.edu.au/moreton-bay-research-station/data-sets)	This data set captures the presence or absence of seagrass, captured in 2015 by the University of Queensland's Moreton Bay Research Station (MBRS).
Seagrass Extent Map, 2011	Moreton Bay Research Station, University of Queensland (https://www.uq.edu.au/moreton-bay-research-station/data-sets)	This data set captures the presence or absence of seagrass, captured in 2011 by the University of Queensland's Moreton Bay Research Station (MBRS).

	research-station/data-sets)	
Seagrass Extent Map, 2004	Moreton Bay Research Station, University of Queensland (https://www.uq.edu.au/moreton-bay-research-station/data-sets)	This data set captures the presence or absence of seagrass, captured in 2004 by the University of Queensland's Moreton Bay Research Station (MBRS).
Reef Extent Map, 2014	Remote Sensing Research Centre, University of Queensland (https://doi.pangaea.de/10.1594/PANGAEA.892402)	This data asset combines reef extent data sets from the Allen Coral Atlas to summarise the reefs throughout the Moreton Bay Marine Park in 2014.
Moreton Bay Marine Park Broadscale Habitat Areas, 2008	Queensland Parks and Wildlife Service and Partnerships, Department of Environment, Science, and Innovation (https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={65300831-53D8-477F-A408-C5835FCF06B0}})	This data set contains the Moreton Bay Marine Park 2008 habitat areas, created by the Queensland Department of Environment, Science, and Innovation. Examples of such habitats include inshore reefs, algae/sponge habitats, and rocky shores.
Moreton Bay Marine Park Zoning, 2008	Queensland Parks and Wildlife Service and Partnerships, Department of Environment, Science, and Innovation (https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={65300831-53D8-477F-A408-C5835FCF06B0}})	This data set contains zoning from the Moreton Bay Marine Park 2008 zoning plan, created by the Queensland Department of Environment, Science, and Innovation. These zones include general use, conservation parks, national marine parks, and habitat protection zones.
Moreton Bay Marine Park Boundary, 2008	Queensland Parks and Wildlife Service and Partnerships, Department of Environment, Science and Innovation (https://qldspatial.information.qld.gov.au/catalogue/custom/detail.page?fid={65300831-53D8-477F-A408-C5835FCF06B0}})	This data represents the Boundary of the Moreton Bay Marine Park, created by merging regions comprising the Moreton Bay Marine Park 2008 zoning plan.

Living and Playing Together

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Bathymetry (sea floor) Map, 2020	DeepReef (https://www.deepreef.org/2010/07/06/gbr-bathy/)	The data set contains a 100m resolution bathymetry model of the Moreton Bay Marine Park's sea floor, created in 2020.
Satellite Mosaic of Moreton Bay, 2018	Allen Coral Atlas (https://allencoralatlas.org)	Satellite mosaics covering the Moreton Bay Marine Park in 2018, provided by the Allen Coral Atlas in partnership with Planet Labs.
Satellite Mosaic of Moreton Bay, 2020	Allen Coral Atlas (https://allencoralatlas.org)	Satellite mosaics covering the Moreton Bay Marine Park in 2020, provided by the Allen Coral Atlas in partnership with Planet Labs.
Satellite Mosaic of Moreton Bay, 2019	Allen Coral Atlas (https://allencoralatlas.org)	Satellite mosaics covering the Moreton Bay Marine Park in 2019, provided by the Allen Coral Atlas in partnership with Planet Labs.
Base Satellite Imagery	Mapbox (https://www.mapbox.com/)	Base Mapbox satellite imagery, covering southeast Queensland.

Appendix B

Living and Playing Together Platform Stories

The stories below are featured in the “Story Mode” of the Living and Playing Together digital platform (see Section 4.1). The Story Mode is a guided, narrative-based interface that presents different themes related to Moreton Bay, such as marine biodiversity, recreational use, and cultural heritage, alongside interactive spatial data. As users scroll through each story, different map layers, imagery, and multimedia elements become active on screen. This appendix provides the text content used in each of these stories as it appears in the platform.

Section	Story Text
Welcome: Living & Playing Together Moreton Bay	Living and Playing Together in Moreton Bay Quandamooka Sea Country, also called Moreton Bay (or simply ‘the Bay’ to the locals), is a unique environment that is home to a wide range of marine life and is also a busy recreation area for humans. To keep our Bay special and sustain it into the future, it is important for marine life to live and humans to play together. To achieve this, we all need to learn more about what goes on below and above the water in the Bay. We invite you to dive into a scientific discovery of the Bay. Take guided tours or explore for yourself the data, maps, videos, 3D models and 360 images based on many studies of the area. If you are a curious resident, there is plenty here for you to learn about the Bay. Take a guided tour, follow a story, or explore for yourself. If you are a researcher or natural resource manager, you can find information about publicly available datasets and learn about monitoring and management projects.
Managing Moreton Bay: Queensland Department of Environment and Science	Managing Moreton Bay The Queensland Government Department of Environment, Science, and Innovation, QPWS and the Quandamooka people via the Quandamooka Yoolooburrabee Aboriginal Corporation (QYAC) actively manage the Moreton Bay Marine Park, which covers roughly 3400 square kilometres from the shoreline to the ocean! These organisations play a large role in living and playing together in the Bay. They are charged with maintaining channels for larger vessels like tankers and ferries, managing the safety of boaters and fishers, protecting the natural environment, and conserving native animals, large marine species, and shore birds.
Managing Moreton Bay: Zoning	Zoning The Moreton Bay Marine Park is a multi-use Marine Protected Area (MPA). Queensland Parks and Wildlife Service (QPWS) is responsible for the day-to-day management of the marine park. Unlike a national park on land where everything is protected to the greatest possible extent, the marine park is zoned to allow a range of recreational and commercial activities to occur while also setting aside some areas for higher protection.

	Different zones permit different activities in the marine park. There are four zone types - General Use Zones, Habitat Protection Zones, Conservation Park Zones, and Marine National Park Zones which provide the highest level of protection. In addition, the marine park plan also includes 'designated areas' to indicate safe areas for ships to travel, areas where vessels cannot moor or anchor, and spaces where vessels must slow down to protect turtles and dugongs from being hit by propellers. Other designated areas indicate reef and grey nurse shark habitats where special rules may apply. The present marine park zoning plan dates to 2008. Zones are reviewed every ten years by the Queensland Department of Environment, Science and Innovation using data such as those you see here on the Living and Playing Together site, to inform how they can best manage the Bay into the future. Moreton Bay Marine Park Zones provided by the Protected Area Strategy and Investment, Queensland Parks and Wildlife Service and Partnerships, Department of Environment, Science and Innovation.
Boats on Moreton Bay: Boats on Moreton Bay	Boats on Moreton Bay Boats are common in Moreton Bay, and a great example of how people live and play in this beautiful place. The Moreton Bay Marine Park provides 'designated areas' that are relevant specifically to boaters and fishers. These include safe areas for ships to travel, areas where vessels cannot moor or anchor over sensitive habitats (e.g., reef and grey nurse shark habitats, and spaces where vessels must slow down to protect turtles and dugongs from getting hit by propeller. Boat location data provided by the Centre for Data Science, Queensland University of Technology. Moreton Bay Marine Park Zones provided by the Protected Area Strategy and Investment, Queensland Parks and Wildlife Service and Partnerships, Department of Environment, Science, and Innovation.
Boats on Moreton Bay: Southern Pumicestone Passage and Bribie Island	The Southern end of Pumicestone Passage and Bribie Island are sheltered from the ocean, making this a popular place for people to launch boats and begin adventures around the Bay. People also moor their boats in this protected channel. Click on the map and move it around or keep scrolling for more story. Boat location data provided by the Centre for Data Science, Queensland University of Technology.
Boats on Moreton Bay: Mulgumpin	Mulgumpin (also known as Moolgumpin or Moorgumpin, meaning "place of sandhills") is one of many beautiful islands in the Bay. It is the third largest sand island in the world. Almost 98% of the Island is the Gheebulum Kunungai (Moreton Island) National Park. The Indigenous

	Ngugi people who live on the Island have a strong connection with the land and sea. Boat location data provided by the Centre for Data Science, Queensland University of Technology.
Boats on Moreton Bay:	On the Western side of Mulgumpin (Moreton Island) is Tangalooma, an artificial site created by the intentional sinking of fifteen vessels between 1960 and 1980 to create a safe anchorage area for boaters. Looking at the boating activity in this area, you can see that sinking the wrecks has been an effective strategy for living and playing together. People, fish, and other marine animals value the miniature local ecosystem. Small vessels regularly moor between the artificial reef and the sandy shore. Corals have colonised the body of the boats, and reef species have moved in with them, including butterflyfish, damselfish, moray eels, and wobbegongs. Boat location data provided by the Centre for Data Science, Queensland University of Technology. Reef extent data provided by the Remote Sensing Research Centre, University of Queensland.
Boats on Moreton Bay: Gheebulum Kunungai	Being on the sheltered side of Mulgumpin and Gheebulum Kunungai allows for regular safe passage of a ferry from the mainland. The Tangalooma wrecks are unique in the Bay in that one can snorkel and see coral without even needing a boat! Another popular site where ferries cross is further south around Peel Island between Victoria Point and Dunwich on Minjerribah (South Stradbroke Island). Satellite imagery provided by the Allen Coral Atlas.
Boats on Moreton Bay: Minjerribah	Minjerribah (North Stradbroke), or 'Straddie' to the locals, is another beautiful island in the Bay. The Quandamooka people have occupied this island for more than 21,000 years. Today, over 2,000 people call Straddie home. This southern section of Moreton Bay is busy! Safe harbours in the area mean many recreational boaters like to spend their weekends here. This area also includes the main transit route between the mainland and Minjerribah. Over 500 native animals and birds, many of which are rare and threatened, also call Straddie home, and the surrounding ocean is teeming with life. Corals grow around Teerk Roo Ra (Peel Island) National Park and nearby at Myora Reef. Six of the world's seven species of marine turtles live here. Boat location data provided by the Centre for Data Science, Queensland University of Technology.
Stories of Science: Research	Stories of Science In addition to offering a plethora of recreational activities, the Moreton Bay Marine Park is an important hub for research activities, where scientists, local communities, and volunteers investigate and collaborate to safeguard its unique marine ecosystems. Through initiatives such as

	seagrass monitoring, species inventory, marine debris clean-ups, and coral health assessments, these dedicated individuals collect vital data and contribute to conservation efforts. Their participation not only enhances research and environmental protection strategies but also raises awareness about the importance of marine conservation. The following are just a few examples of the eyes and effort directed to understanding and protecting Moreton Bay. Flinders Reef imagery provided by Underwater Earth, University of Queensland. Photomosaics provided by Sustainable Urban Seascapes Moreton Bay, University of Queensland. Satellite imagery provided by the Allen Coral Atlas.
Stories of Science: Citizen Science	Citizen Science Citizen science projects provide opportunities for the public to get involved in monitoring the Bay. In areas where coral ecosystems exist, organisations work with volunteers to monitor coral health, bleaching events, and recovery processes. One of these groups, Reef Check Australia, has been active in Moreton Bay since 2007. The blue dots that you can see on the map are the sites monitored by Reef Check. With some sites now having almost 20 years of observations, we can begin to understand trends in coral growth, invertebrate life, and human impacts on these reefs. Researchers routinely monitor which fish visit the Bay using underwater cameras and acoustic sensors. This effort is assisted by citizen scientists who photograph marine life during dives or snorkelling trips and contribute to species databases. These joint contributions help to track the presence and movement of both vulnerable and invasive species and are even being used to train computers to identify different species of fish! By blending hands-on action with education, citizen science programs in the Bay foster a deep connection between people and the marine environment, encouraging stewardship and a collective responsibility towards its preservation. This collaborative approach ensures the park remains a treasured natural resource for generations to come, balancing human enjoyment with ecological sustainability. Videos of fish provided by the Moreton Bay Live project, Coastal and Marine Research Centre, Griffith University. Reef monitoring data provided by Reef Check Australia.
Stories of Science: Marine Life	Marine Life Did you know that reefs within Moreton Bay Marine Park outside the estuary and in the open ocean can look and feel like the Great Barrier Reef? Flinders Reef has dense thickets of branching coral, visiting turtles, and table corals big enough for a full dinner party! In the winter we can hear humpback whales singing as they pass by.

	CoralWatch is another coral monitoring organisation that integrates volunteer monitoring activities with community education about coral reefs. CoralWatch and other programs like SeagrassWatch and MangroveWatch help to make sure we can continue to experience this amazing environment while also maintaining it. Videos of fish provided by the Moreton Bay Live project, Coastal and Marine Research Centre, Griffith University. Reef monitoring data provided by Reef Check Australia.
Stories of Science: Acoustic Sensors	Throughout the Bay, visitors often see turtles and dolphins. The reefs just outside the Bay are visited by manta rays, leopard sharks, grey nurse sharks, schools of fish, and beautiful fields of algae and soft coral. Within the Bay there is a range of depth, tides, and sandbanks. There are also large and changing fields of seagrass. Seagrasses help trap sediment after floods, support wildlife such as dugongs, and are a nursery for many important fisheries species. We are lucky to have many species of seagrass thriving within the Bay. These have been studied over the years by programmes such as the University of Queensland's Remote Sensing Research Centre. Seagrass data provided by the Moreton Bay Research Station, University of Queensland. Bathymetry data provided by DeepReef.
Stories of Science:	Scientists in Southeast Queensland are always finding new ways to use technology to better understand the ecology of the Bay. Videos such as the ones you can click on here, are camera traps are used by the Griffith University Global Wetlands Project to train computers to identify fish. This can allow for better and quicker understanding of fish populations in the Bay so that we can manage both recreational and commercial fishing into the future. Videos of fish provided by the Moreton Bay Live project, Coastal and Marine Research Centre, Griffith University.
Stories of Science:	The University of Sunshine Coast has led research that helps us understand more about the larger species either living in or travelling through the Bay. Researchers tags animals, then put out an acoustic receiver. They can then observe whenever a tagged individual swims near a receiver. Look at all the residents they have tracked here! Acoustic data provided by the Australian Animal Acoustic Telemetry Database, Australian Ocean Data Network.
Stories of Science:	This estuarine area is special to the wildlife too. Here, shallow seagrass beds are home for all sorts of species. Using acoustic sensors that the University of Sunshine Coast has installed in this area, we have learnt that many birds, turtles, dugong, crabs, other invertebrates, and fish spend a lot of time here. We also know about how the seagrass has been growing and changing there for the last several years using innovative work by the University of Queensland observing seagrass across the entirety of MB.

	Acoustic data provided by the Australian Animal Acoustic Telemetry Database, Australian Ocean Data Network. Seagrass data provided by the Moreton Bay Research Station, University of Queensland. Beyond the coast of Bribie Island is where the ocean starts and we expand out and to other environments, such as reefs and deeper water. Explore the bathymetry layer or some images of Flinders Reef if you want to see what it is like out there. Wetland extent data provided by the Queensland Department of Environment, Science, and Innovation. Bathymetry data provided by DeepReef.
Valuing Moreton Bay: Appreciate Moreton Bay	Appreciating Moreton Bay Balancing human enjoyment and recreation, transport, and resource extraction with maintaining a healthy bay is what the Marine Park is all about. People enjoy many different areas within the Bay for a wide range of reasons. Some people want to experience nature, appreciate natural beauty, or just relax away from the busyness of day-to-day life. Boat location data provided by the Centre for Data Science, Queensland University of Technology. Moreton Bay Values survey data provided by the University of Queensland.
Valuing Moreton Bay: Valuing Sites	Other people like to simply explore different places throughout the Bay or discover new fishing locations. Researchers at UQ have conducted a survey to understand how people appreciate different parts of the Bay so that these values are considered in future management decisions. Moreton Bay Values survey data provided by the University of Queensland. Moreton Bay Marine Park Zones provided by the Protected Area Strategy and Investment, Queensland Parks and Wildlife Service and Partnerships, Department of Environment, Science, and Innovation.
Valuing Moreton Bay: Olympics 2032	The Moreton Bay Marine Park is visited by people from many places and visitor numbers are increasing! The Summer Olympics in 2032 will bring in more international tourists than ever before. It is a good thing that the strong foundation of science, management and community engagement will help us protect the Bay for people and wildlife.
About the project: Resources	About the project This site introduces you to the people and marine life living and playing in these areas. The Living and Playing Together platform is only an entry point for understanding the unique beauty of the Bay, highlighting how lucky we are to have this incredible environment right next to the third largest population centre in Australia. Continue to explore the data through the websites of our various data providers. Contact them for access to their data or for volunteer/study opportunities. If you want to learn more, you can explore the data.