AUSTRALIAN
MARINE DEBRIS INITIATIVE

AMDI MONITORING PROTOCOLS FOR LITTER AND MARINE DEBRIS

MONITORING LITTER PATHWAYS






Australian Marine Debris Initiative Database protocols to monitor and collect litter and marine debris data along different litter pathways.

Release date: May 2022

Creative Commons License (CC BY-NC-SA 4.0)

Disclaimer

Contact

Tangaroa Blue Foundation
PO Box 1235
Dunsborough
WA 6281 Australia

info@tangaroablue.org

Citation

Tangaroa Blue Foundation, 2022, AMDI Monitoring Protocols for Litter and Marine Debris, retrieved from https://www.tangaroablue.org

Published

Electronically released by Tangaroa Blue Foundation (TBF) in May 2022.

Acknowledgements

Tangaroa Blue Foundation would like to acknowledge the Traditional Custodians of the land on which we work and live, and pay our respects to elders past, present and emerging.

Tangaroa Blue Foundation would like to acknowledge the Mostyn Family Foundation and the Australian Citizen Science Association who kindly supported the development of this publication.

Contributors

Partners of the Australian Marine Debris Initiative (AMDI) who contributed to this document include:

- Tangaroa Blue Foundation - Alexis Farr, Dr Daniel Burns, Jodi Jones, Carly Alexander and Heidi Tait
- University of New South Wales - Jordan Gacutan and Dr Graeme Clark
- University of Tasmania / Adrift Lab - Dr Jennifer Lavers
- AUSMAP / Macquarie University - Dr Scott Wilson and Dr Michelle Blewitt
- Southern Cross University - Professor Steve Smith

Summary

Coastal and marine ecosystems are increasingly threatened by marine debris, which impacts marine species and their habitats at a global scale. Interventions to prevent the escape and/or removal of or marine debris, such as waste management infrastructure, improved regulations, and educational campaigns are most effective when they are informed by the local context. Understanding the abundance of specific debris items and their tendency to disperse enables us to trace the items to their source, to inform effective and efficient management intervention.

To understand the local context, and measure whether a source reduction plan is working, long-term monitoring is required. Monitoring refers to surveys performed consistently over regular intervals, using appropriate methods that are adapted to the type of site. Through the use of standardised methods across different site types, monitoring programs provide a greater understanding of marine debris flows from source (e.g. rivers and estuaries) to sink (e.g. the ocean). Regular monitoring also provides a better understanding of the overall debris trends (whether increasing or decreasing) within a management area.

With the right training and protocols, citizen scientists can perform monitoring, which will significantly increase the amount of data (both over space and time) to inform source reduction efforts. Tangaroa Blue Foundation recognises the vital role that volunteers and community groups play in improving our understanding of debris at local scales, which is vital to providing the best management solution to the problem.

This document provides protocols for establishing and performing monitoring at a chosen site. It includes standardised methods for collecting and recording debris data at different site types, allowing citizen scientists to tailor monitoring activities to a specific site. By establishing monitoring sites, citizen scientists, local councils, organisations, businesses and community groups can help with developing the Source Reduction Plans (SRPs) needed to adequately address the growing challenge of marine debris.

Throughout this document the terms 'litter' and 'marine debris' will be used to refer to all types of pollution. Rubbish, pollution, waste or debris will be referred to as 'litter' on land, and 'marine debris' in marine environments.

This document is structured into the following sections:

- The need for monitoring (Section 1)
- Getting ready to monitor (training, site types and site selection) (Sections 2, 3 and 4)
- Monitoring protocols per site type (Section 5)
  - On the Ground Monitoring
  - Built Drainage Monitoring
  - Inland Waterways Monitoring
  - Estuary Monitoring
  - Coastal Shoreline Monitoring
  - Underwater Monitoring
- Collecting and entering data into the AMDI Database (Sections 6 and 7)
- References (Section 8)
- Resources (Section 9).

Table of Contents

1. Introduction

"We are in reach of a whole new relationship with the ocean, a wiser, more sustainable relationship. ***The choice lies with us****.' - Sir David Attenborough.*

Environments, cultures and economies are increasingly threatened by marine debris. Each year, millions of tonnes of plastic enter the ocean[1], travelling from release sources and through geographical land features including on the ground sites, built drainage, inland waterways, estuaries, and coastal shorelines to the ocean.

The removal and prevention of litter and marine debris within the environment is a global challenge, and increasing awareness has led to campaigns at varying scales (from local to international) to reduce litter from 'leaking' into the ocean as marine debris. The most effective way of reducing marine debris is to stop litter at the source, through improved regulations and compliance, waste management systems, education campaigns and consumer behaviour change. These interventions are most effective when they are informed by robust data and management can be performed through Source Reduction Plans (SRPs).

Tangaroa Blue Foundation recognises the vital role that volunteers and community groups play in improving our understanding of marine debris, and their contribution to the collection of data and identification of solutions for the future prevention of marine debris.

The difference between clean-ups and monitoring

Marine debris is human-created waste that has deliberately or accidentally been released into the ocean. Marine debris data can be collected through surveys from community clean-ups or structured monitoring programs.

Community clean-up surveys are the most common approach to litter reduction around the world, due to their accessibility and the flexibility of methods for data collection. Community clean-up activities and litter hotspot surveys are useful to clean the environment and to gain an understanding of debris issues. However, the inconsistency of data collected during clean-ups limits analysis. To understand the flow of marine debris to a location over time, more rigorous and consistent methodologies should be used.

Structured monitoring frameworks aim to create long-term, high-quality datasets using project management strategies that define locations, land types, user types and survey frequency.

Monitoring refers to surveys performed consistently over regular intervals (e.g. every 3 months), using appropriate methods for each different type of site. Through the application of standardised methods across different site types, monitoring programs can provide a greater understanding of marine debris flows from the source (land or waterways) to sink (the ocean). Regular monitoring also improves the quality of existing datasets in a region, which can be used to evaluate the success of intervention and source reduction measures, such as the ban of single-use plastic items, container deposit schemes, or investment in stormwater infrastructure (e.g. gross pollutant traps).

[1] *Jambeck, J.R. et al., 2015, 'Plastic waste inputs from land into the ocean', Science, Vol. 347, No. 6223, pp.768-771 ; Borelle, S.B. et al. 2020 'Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution' Science 369 (6510), 1515-1518.*

Citizen scientists and monitoring

Monitoring programs have traditionally been government-led and undertaken by institutional research entities, which can be expensive and time consuming. These limitations leave gaps in the datasets which can be filled by citizen scientists. Citizen scientists can readily support a range of efforts by using standardised data collection methodologies.

Tangaroa Blue Foundation (TBF) supports citizen scientists, volunteers, Indigenous groups, community groups and organisations through the facilitation of the Australian Marine Debris Initiative (AMDI), a network of more than 2,000 partner organisations.

The AMDI provides:

- a standardised classification system for recording debris,
- a place to contribute and store the data, through the AMDI Database, and
- a way to use the data to facilitate and measure local Source Reduction Plans.

The AMDI supports both small and large-scale debris projects and programs, warehousing a diverse range of data, including clean-up surveys contributed by community and volunteer networks, research and project management organisations and litter management programs both nationally and internationally.

Using AMDI data, you will be able to understand at an itemised and quantifiable level the marine debris signature of your area, and start impactful data-led conversations with stakeholder groups to develop litter and marine debris reduction strategies.

Purpose of this document

This document provides community organisations, Indigenous groups, citizen scientists, government and not for profit organisations, methodologies and rationale for establishing marine debris and litter monitoring projects, data collection and assessment programs across different land types, locations and settings, from inland to coastal environments.

Supporting scientific analysis of litter and marine debris released into economically, culturally and environmentally sensitive habitats through the provision of standardised field data collection methodologies.

2. Training

Why is training important?

Regular monitoring gives us a better understanding of the marine debris problem and how best to manage it. However, monitoring is more complicated than standard clean-ups, and to make sure that you understand how (and why) we use specific methods, training on these monitoring protocols is required.

Training is important to:

- familiarise yourself with the monitoring methods relevant to your chosen site.
- ensure that you provide consistent and reliable data to address the marine debris challenge.
- provide a way to interact with other groups that are monitoring similar sites, and share challenges and insights that could benefit the whole community.

What training is provided?

All citizen scientist volunteers will have the opportunity to complete training with Tangaroa Blue Foundation prior to commencing a monitoring activity. Training will offer volunteers context on the purpose and aims of the work, and provide guidance on the procedures and practicalities of monitoring, data collection and data entry.

3. Site Types

To understand how litter travels from where it is first released (source), to where it arrives (sink), we need to monitor different types of land-use sectors.

In this guide, we break down monitoring methodologies and site types based on the stages of a catchment, including:

- On the ground (the point when rainfall hits the ground and flows overland to the next site type)
- Built drainage
- Inland waterways
- Estuaries
- Coastal shorelines
- Underwater.

Litter can be transported through a combination of these stages, or 'litter pathways'. Recording where, how and what kinds of debris move between sites can give an understanding of where intervention points would best be placed along a catchment. The opportunity to prevent, mitigate and remove debris progressively decreases as litter travels towards the ocean. Conversely, the chance of litter reaching the ocean increases the further it travels along the pathway.

Site types and how they connect

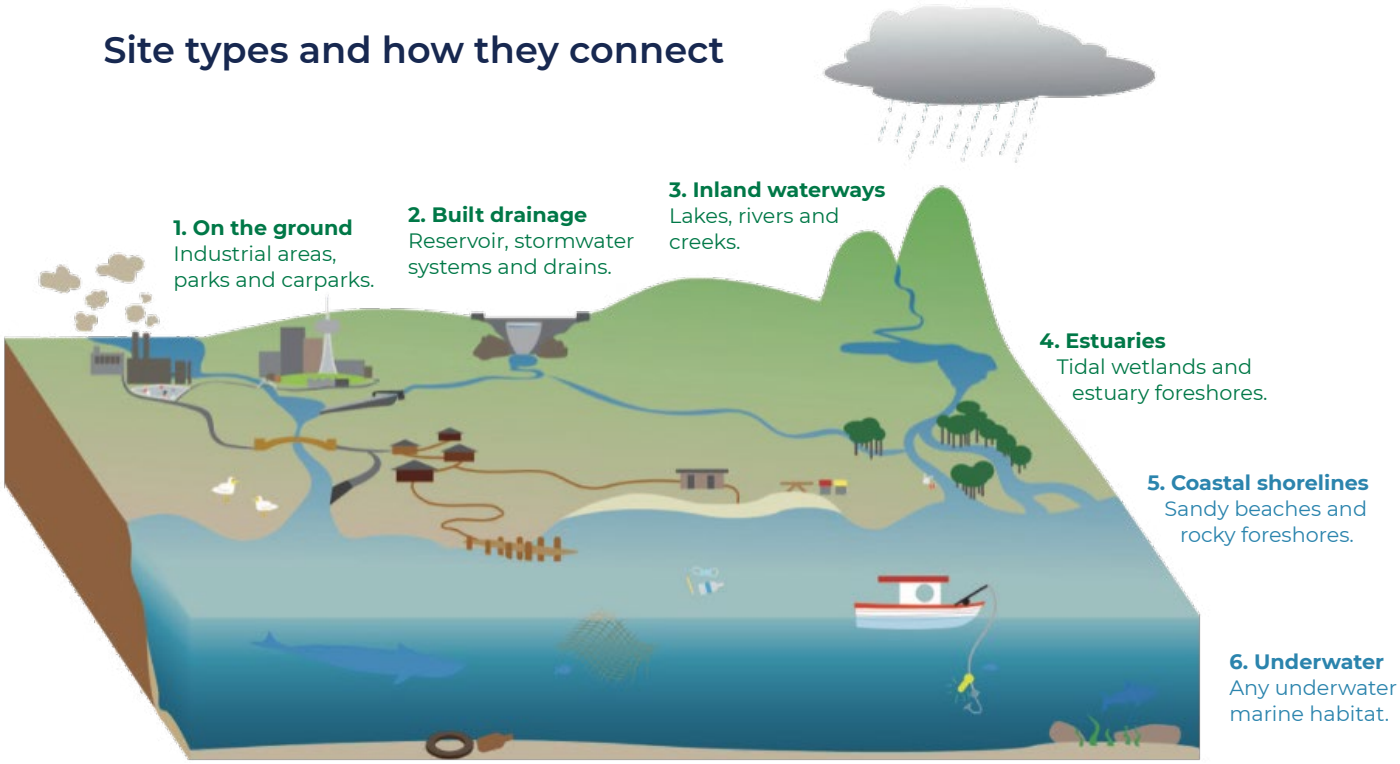


Table 3.1. Summary of site types and examples, including things to consider before choosing a site type.

Site type	Definition	Examples	Things to consider
On the ground	Locations where litter is found before entering into the aquatic environment (waterways, estuaries, beaches) or built infrastructure (drainage network).	Areas near waterways: ■ parks and green spaces ■ sports fields / ovals ■ open areas ■ infrastructure-adjacent areas. Areas near built drainage: ■ school grounds (open to public and outside school hours) ■ around amenities ■ outside shopping centres ■ carparks	**Do not** sample in hazardous areas or on private land, such as: ■ busy roads / highways ■ fenced-off areas ■ areas covered under other site type definitions *As this site type is the most varied, please consult Tangaroa Blue Foundation for assistance.*
Built drainage	All parts of the drainage network, extending from drain entry to outfall.	■ drains ■ gross pollutant traps	**Do not** open drains or gross pollutant traps owned by the council or a business. This site type is only relevant to people who have permission to access the asset or have partnered with the relevant organisation. Monitoring will most likely be conducted on assets such as Gross Pollutant Traps (GPTs) and debris caught in Stormwater Quality Improvement Devices (SQIDs). When reporting, the data should indicate the type of asset, its make and model.
Inland waterways	Banks of freshwater waterways.	■ foreshore / banks of catchment channels, creeks, rivers, and lakes	Access points may restrict where you can collect data.

Estuaries	Banks of brackish waterways, where freshwater from rivers and streams meets the sea.	■ tidal wetlands ■ foreshore / banks of estuaries	Access points may restrict where you can collect data.
Coastal shorelines	Locations facing the ocean (outside estuaries) and immediately adjacent to the ocean.	■ sandy beaches ■ rocky shores ■ other beach types (pebble, mud)	**Do** note any factors which may influence debris, including adjacent / underwater habitats (e.g., mangroves, saltmarsh, seagrass) and other built infrastructure (groynes, breakwaters and seawalls).
Underwater	The underwater sector refers to monitoring in **marine** waters that extend beyond a coastal zone.	■ any marine underwater habitat *This sampling will be conducted via SCUBA or freediving. Only trained and certified divers should monitor underwater sites.*	**Do not** attempt underwater monitoring if you are not a trained and certified scuba diver or freediver.

4. Site Selection and Planning

Site selection

The first step to establishing a monitoring site is the careful selection of a site location, taking into consideration a range of factors. These may include:

- Safety - Identifying, understanding and mitigating risks for a site
- Accessibility - Ensuring land owner/manager permissions and reliable access to the site
- Extent - Bounds of the site (where it starts and stops)
- Data value - Need to fill data gaps and meet the objectives of the monitoring program
- Traffic - Likelihood of intervention by other programs to the site
- Social factors - Potential disruptions to the community
- Cultural factors - Consultation with Traditional Owners
- Environmental factors - Potential environmental impacts from a monitoring program

Prior to selecting a site, it is important to understand any limitations you may have to reliably access the site and conduct monitoring in a safe manner. Tangaroa Blue Foundation provides an open list of sites that are ideal for monitoring and you are welcome to adopt one of the sites listed. If you intend to conduct a monitoring activity outside of the sites listed, we encourage you to have an initial consultation with Tangaroa Blue Foundation, to ensure the best possible data quality and that you meet the needs of your monitoring program. This will involve accounting for a wide range of geographical differences, such as population density or proximity to roads and waterways, as well as accessibility issues such as annual monsoonal flooding.

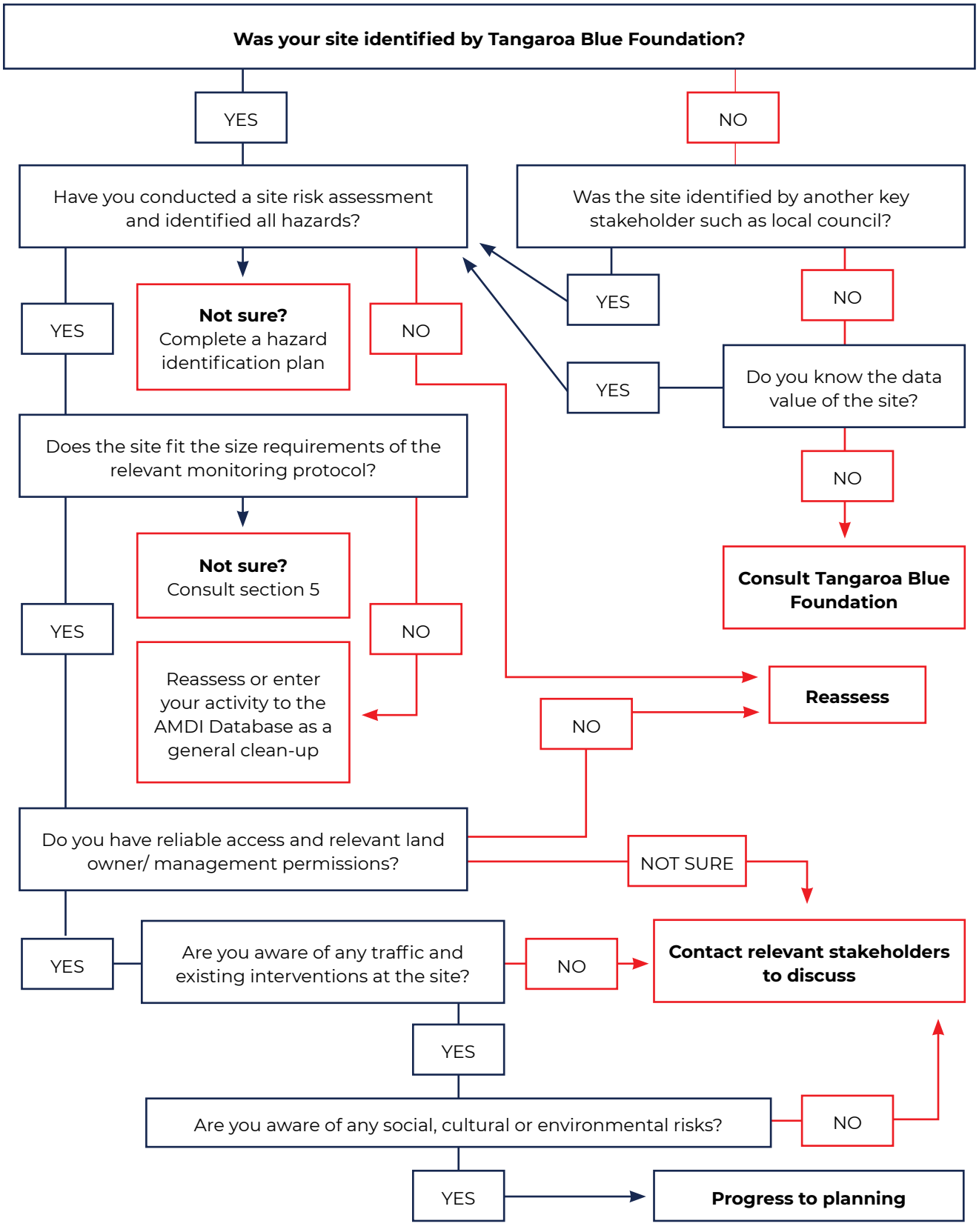
You will also need to consider social and environmental factors at your chosen location: is it a significant cultural site; important to fauna, such as nesting birds; or covered by vegetation at certain times of the year? It is recommended that you consult with the Traditional Owners of the site that you have in mind, prior to planning a monitoring program. Monitoring should not be conducted at locations where your activities could result in harmful impacts on the environment or culturally significant areas.

If your site does not align with the relevant monitoring protocol (e.g., if the site is too small to complete all transects required), you can still enter the data for your activity into the AMDI Database as a general clean-up.

Safety is the number one priority during monitoring, and all risks must be identified, documented and addressed to ensure that you and your participants are safe during your activity. Specific occupational health and safety protocols should be considered, with guidance provided in the Tangaroa Blue Foundation Work Health and Safety Management Strategy.

MONITORING SITE SELECTION TOOL

AUSTRALIAN MARINE DEBRIS INITIATIVE



Site inspection

Before conducting any monitoring, you must first ensure you have all relevant approvals to visit your site for an initial inspection. During this site inspection record site characteristics and complete a risk assessment for your activity, including:

- Considering issues that might arise during data collection such as accessibility, landscape transformations over time, and health and safety risks. We recommend you refer to the Tangaroa Blue Foundation Work Health and Safety Management Strategy for guidance. In particular, refer to Appendix A of the document, *Hazard Identification Plan*.
- Note the existing facilities or programs which may be in place to reduce littering or debris. This will be an important factor when selecting dates and times for monitoring.
- Visually assess the area and the amount of visible litter to get an idea of the time, effort and resources required for monitoring. Decide whether you can sort and itemise the debris on site, or if you will need to do this at another location.

Preparing the site (initial clean-up)

After the initial scoping of the site and consultation with Tangaroa Blue Foundation, you are ready for monitoring! To ensure that you detect new debris entering the site, you must first establish a baseline by cleaning up as much of the existing debris as possible, noting any debris that is inaccessible (buried, entangled, too heavy etc.). This activity should be included in your monitoring schedule and submitted to the AMDI Database as a general clean-up. Be sure to make a clear note in the data report that it is the baseline survey for your monitoring program. Subsequent monitoring clean-ups will use the protocols described in **Section 5**.

Survey frequency

The frequency of surveys is site dependent. The minimum requirement for a monitoring site is sampling at quarterly (3 month) intervals, however stormwater asset audits need to be completed at 8-week intervals. For example, you could conduct coastal shoreline monitoring activities in March, June, September and December of each year to account for seasonal changes in variables (prevailing wind, weather, tides etc.). The frequency and approximate dates of your surveys should be kept consistent from year to year.

More frequent monitoring during the initial phases of the project (eg., monthly, every 8 weeks) may be helpful to ascertain the optimal sampling interval for your site. Sites with high amounts of debris flowing in and out of the system can be monitored more regularly, to get a better understanding of the sources of debris. This could be fortnightly or monthly as needed, depending on your capacity and resources. However, it is important to ensure that monitoring activities are spaced at regular intervals so that your dataset can be easily standardised and interpreted. In addition, you may want to target local events (such as outdoor concerts or festivals) and conduct a clean-up of the area before and after the event. If you do complete additional monitoring sessions like this, please make sure to include a note about the event and monitoring activity with your dataset.

Do I need to monitor the same location every time?

The extent of a monitoring site is defined at the commencement of the monitoring program and should remain consistent over time. However, the sampling within the site may change depending on the site type (consult Section 5). To ensure a robust dataset and avoid bias, follow the specified methodology for the land-use sector you wish to survey. When setting transects, you will select the first starting points for your transects at random. For all subsequent visits, return to the same transect starting points again.

Changes to the site

Over time, activities (e.g. construction) and access to a site may change. If you have issues with site access, or find that there is something affecting your site that may skew your dataset (e.g., beach nets blocking debris or construction), contact Tangaroa Blue Foundation and we will work with you to determine potential solutions or select another appropriate site and ensure that we track changes in the dataset associated with your monitoring program.

5. Methodologies

There are a range of approaches used to monitor different site types. Table 5.1 provides a broad overview of these monitoring methodologies, which will be explained in more detail below.

Table 5.1 Monitoring methodology used for each site type.

Site type	Monitoring methodology
On the ground	9 x 10m(+)(L) x 2m (W) transects Transects are conducted across 3 area types: Amenity area, Transition zone and Representation area
Built drainage	Gross pollutant traps installed Traps monitored at 8-week intervals, for 6 cycles/ year
Inland waterways	4 x 25m(L) transects, parallel to waterline
Estuaries	4 x 25m(L) transects, parallel to waterline
Coastal shorelines	4 x 25m(L) transects, parallel to waterline
Underwater	4 x 25m(L) x 5m (W) transects, from a boat or shoreline

Microplastics

AUSMAP microplastic assessments may be conducted at any suitable location in addition to macro litter and marine debris surveys. For more information on completing AUSMAP microplastic assessments refer to AUSMAP, www.ausmap.org

5.1 ON THE GROUND MONITORING

On the ground sites cover a variety of land-uses including parks, recreational reserves, schools, shopping districts, industrial areas and public transport zones. The purpose of an on the ground survey is to locate litter as close as possible to its source and identify where interventions can be implemented to prevent litter moving further into waterways and built infrastructure. This methodology can be applied to a range of settings and scales, although the example we use here is a parkland with defined minimal spatial requirements. On the ground monitoring can be adapted to smaller scales and target items (e.g., cigarette butts, plastic resin pellets or hotspot ratings) in consultation with the AMDI Database team.

When monitoring an on the ground site, we should consider the different types and unique uses of space within a site. An open recreational parkland, for example, may include a carpark, picnic tables, skate parks, play equipment and other amenities. Parks are also used to host activities such as sports events, markets or festivals. These factors may result in a dataset that is biased towards a single type of litter item (e.g., cigarettes or balloons). Site maintenance and cleaning schedules will also influence the litter load on a site and may reduce litter loadings at the time of monitoring. Therefore, when selecting your site it is important to find out as much as you can about the uses and maintenance schedules of your chosen location.

Equipment required

The equipment required for an on the ground monitoring includes:

- Tape measure (10m)
- Transect markers
- Litter bags (individual bags for each transect, plus extra bags for additional areas cleaned)
- Gloves
- Random number generator (website tool or phone app)
- Data recording sheets and pencil or the AMDI app (on phone or tablet)
- Knife or scissors
- Scales
- First aid kit
- Sharps container
- Digital camera (optional)
- GPS or location sharing app (what3words or Emergency plus App)

Defining the survey boundary per land-use type

On the ground areas cover a range of land-use types, so before monitoring you must define the different land-uses within your on the ground site. Each monitoring site should contain three different land-use types: an amenity area, a transition zone and a representation area (defined below). Within each land-use area you will sample 3 transects, in total you will have 9 data samples from the site.

Using the example of a recreational parkland, land-use areas are defined as follows:

Amenity Area where facilities or structures are located (e.g., bins, bus stops, kiosks, benches, shelters, structures, playgrounds, skate parks or toilet blocks). The amenity area boundary line may need to curve around these amenities and structures, but should not double back. The **minimum** land-use area for an amenity area should be 90m length x 2m width.

Transition Zone in and out of the parkland including marked entrances, carparks, river foreshore lines etc. The **minimum** land-use area for a transition zone should be 90m length x 2m width.

Representation Area or open space (e.g., a grass field, sports oval). The **minimum** land-use area for a representation area should be 90m length x 2m width.

The reason for this approach is to understand how litter moves and distributes across different land-use areas, with a long-term objective to target litter along its source pathways. You will need to divide the site into manageable segments and scale surveys to best fit the area and survey objectives. This will require using an online mapping tool such as Google Earth to find the coordinates of points, add markers, and measure areas and distances.

Note: If the site you wish to survey does not fit the minimum land-use area requirements of this methodology, please enter your data as a general clean-up in the AMDI Database, rather than a monitoring site.

The example of a parkland site below (Image 5.1) covers a large area including amenities blocks, parking zones and a sports field. This site was broken into three different monitoring areas: an amenity area (facilities), transition zone (carpark) and representation area (sports field).

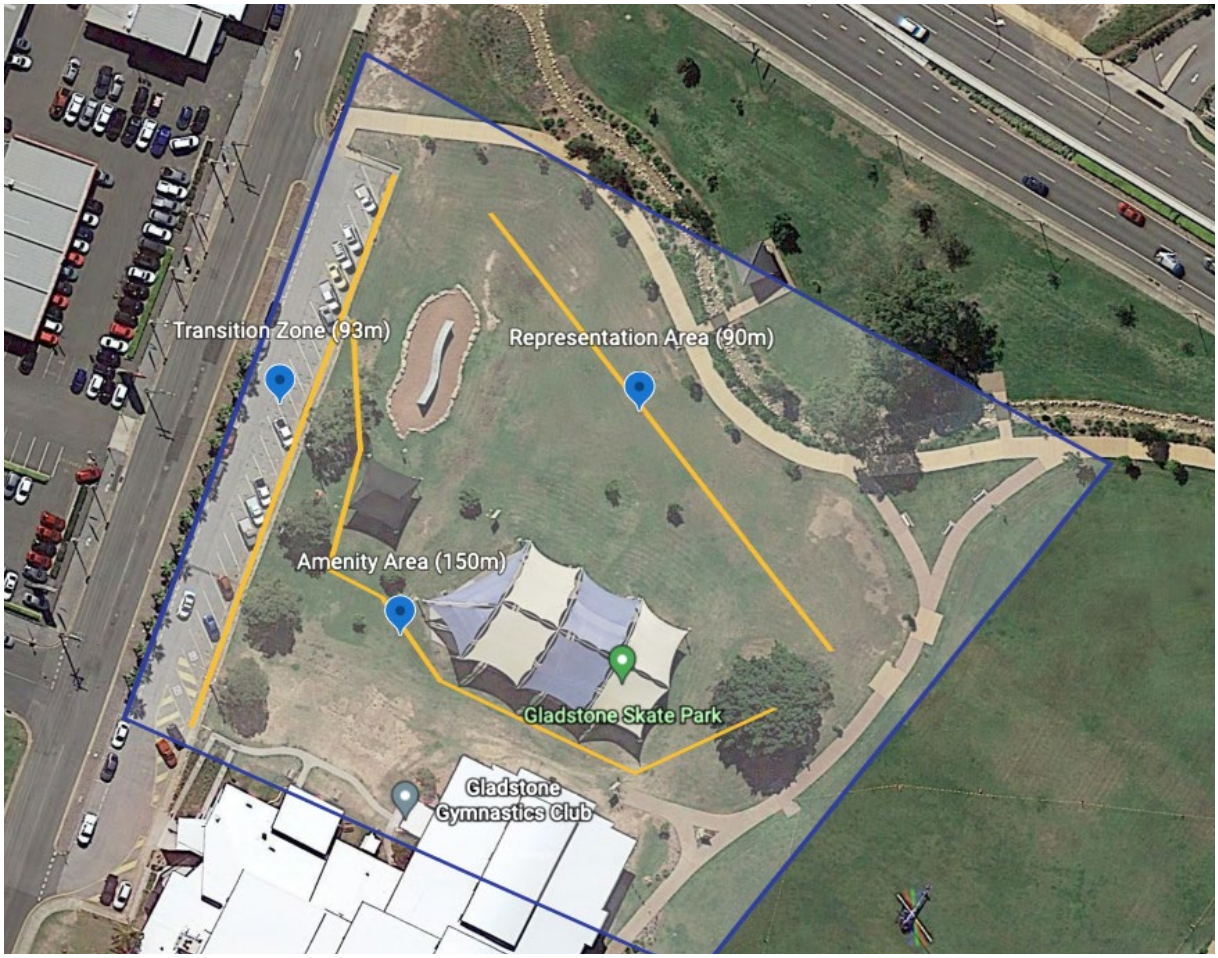


Image 5.1. Memorial Park, Gladstone QLD - Overview of monitoring areas*.

* Image credit: Google Earth

Monitoring approach per land-use area

Once you have defined the land-use areas within your on the ground site, you will set up transects to monitor debris.

The following steps are performed for all land-use areas within the site:

- Define the land-use types within a site and measure the area of each one.
- Delineate each land-use area by drawing a line through it.
- Set up the transects.
- Survey and record the data

Measuring your area

Amenity Area

To begin mapping your amenity area, use your software (e.g. Google Earth) to draw a line from an identifiable starting point (such as the parkland entrance) and run through the various amenities as directly as possible. It may be necessary to curve the path of your line to work around the shape of the amenity features (such as the example in Image 5.2 below). It may help to use stable markers (e.g., a tree or play equipment) to guide the start and end points of your area. In this example, the distance through the amenity area across the features is 150 metres.

Image 5.2 - Amenity Area (150m)*.

* Image credit: Google Earth

Transition Zone

Next, measure the length in metres of the entire transition zone. In the example shown below, the transition zone is a carpark which is adjacent to stormwater drains, and 93m in length.

Image 5.3 - Transition Zone (93m)*.

Representation Zone

Measure a line through the open space without any built features to delineate your representation area, ensuring that you have a land-use area of a minimum 90m length x 2m width.

Image 5.4 - Representation Area (90m)*.

* Image credit: Google Earth

Setting transects

The nature and location of your on the ground site will determine the amenities (seating, play equipment and other features) installed, and it is not uncommon for certain structures to have higher and quite specific litter loads than others. To ensure a robust dataset and avoid bias towards specific areas, initially select the points to begin your transects at random. For all subsequent visits, return to the same transect starting points again.

To find the points to begin your transects, you will use a random number generator, and each number within your selected range will represent a one metre distance from the starting point. You can use a website tool or app, whichever is easiest. For the random number generator, you will need to define an upper and lower limit according to the total length of your land-use area sections. The lower limit will always be 0. To determine the upper limit, take the total length of the area and subtract the length of one transect (e.g. 10 metres). It is better to do longer transects if possible, but this will depend on the time and resources you have available, as well as the size of your three land-use areas.

When you are on site and ready to measure your first transect, situate yourself at the starting point. Next use the random number generator to find the number of metres you should walk from the starting point, and commence your first transect at that point. **Each transect should be 2m wide and a minimum of 10m in length**. Please ensure that the length of all transects, whether 10 metres or more, is consistent across all nine transects.

You will repeat this process another two times, using a random number generator to determine how far from the starting point to commence each transect. If your random number generator produces a number that would result in overlapping transects, choose another random number until there is no overlap. For example, if your first transect commences at 134m from the starting point, and the random number generator produces the number 151m for you to begin your second transect, simply generate another random number until there is no overlap between transects. If the random number generator produces a number that requires you to begin a transect in a location that is inaccessible, move to the closest accessible point from that location and begin your transect.

Example

In the example at Memorial Park Gladstone, our Amenity Area was mapped using a line of 150m. We took the total length of the area (150m) and subtracted the length of one transect (10m). This gave us a random number upper limit of 140.

On arrival at the site, we randomly generated three points to begin our transects, in a range of 0 to 140m.

- The first number we generated was 3, so we walked 3 metres from the top of the area to place our first transect.
- The second random number we generated was 58, so we walked 58 metres from the starting point and placed our second transect.
- The third random number we selected was 65, however this would overlap with our second transect, so we generated a new number.
- This number was 117, so we walked to 117 metres from the starting point and placed our third transect.

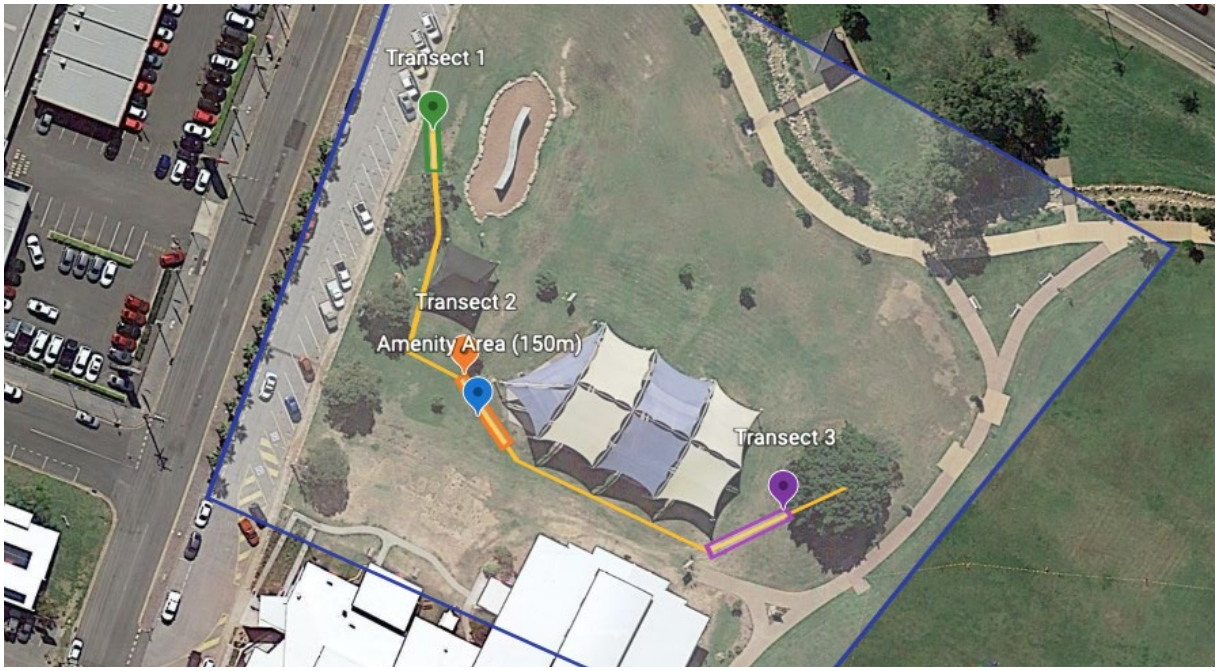


Image 5.5 - Points to begin the transects are selected using a random number generator*.

Repeat this process for each of your three area types - Amenity Area, Transition Zone and Representation Area.

In total, you should have 9 randomly selected transects. Keep your map, measurements and GPS points of where each transect was located on file.

Survey

Remove all debris items greater than 5mm from the area and place into a labelled bag. Litter found in each of the transect areas should be placed into separate, labelled bags. If there is no litter in one or more of your transects, mark it as 'zero litter found'. Finding no litter in an area is still valuable data, and should be recorded. In addition to your transects, we suggest conducting a whole area clean-up at the end of your monitoring activity. Debris found outside the transects should be bagged and recorded separately (see details below). If you find an item (for example, a piece of fishing net) that cuts across the transect line, include the entire item. Record the number of volunteers and time taken during clean-up and sorting.

Records

When you set up your monitoring project with Tangaroa Blue Foundation we will designate a unique project tracking code to your project and monitoring area in the AMDI Database geospatial mapping dataset. You will submit 10 survey results each time you complete a monitoring activity, along with a state of the environment report:

- Amenity Area Transects, 1-3
- Transition Zone Transects, 1-3
- Representation Area Transects, 1-3
- General area clean-up of all litter (completed after transect surveys).

* Image credit: Google Earth

5.2 BUILT DRAINAGE MONITORING

Getting started

The type and amount of land-based debris entering aquatic environments via the stormwater system is poorly understood. To address this knowledge gap, audits of what is captured in drainage infrastructure can be performed using the methods outlined in this document, providing location-specific data on the source and density of litter within a local area, whilst also preventing further pollutants from entering our waterways.

Typically, drains in the built environment are not well maintained and are susceptible to overflow, which leads to litter escaping from the trap. Your dataset can be used to understand if the trap is effective, identify the likely sources of pollutants, and engage with local communities through citizen science.

When commencing a monitoring program in the built environment, you must collaborate with a range of stakeholders and asset managers to support you, including:

- Local Government Area (LGA) councils
- asset owners
- infrastructure service providers.

Do not access built drainage infrastructure unless you have permission and hold the appropriate training and insurance. The best way to perform this monitoring is in partnership with the asset owner and infrastructure service providers responsible for the installation, maintenance and servicing of the infrastructure.

Built drainage monitoring is normally in partnership with LGA councils or land managers so that planning around asset purchases, installation, servicing and ongoing maintenance can be agreed on prior to the project beginning.

The dataset you create can assist councils in establishing a servicing schedule for their drain assets, according to the quantity of debris in each of the traps across locations, and whether or not they are overflowing.

Site selection

If you are in a position to inform monitoring through council and/or other stormwater infrastructure efforts, consider the placement of traps to maximise the quality of data that will be gathered. The optimal placement of traps is to distribute them evenly across hotspot areas, selected from within six land-use types. The purpose of this is to compare debris types and abundance across zones.

Land-use types may include:

- CBDs
- Industrial precincts
- Shopping centres
- Public transport terminals
- Residential areas
- Recreational areas (parks, beaches etc.)

Sites should be chosen in consultation with relevant stakeholders and asset managers. When selecting a site, it is important to understand your limitations. Make sure to clarify:

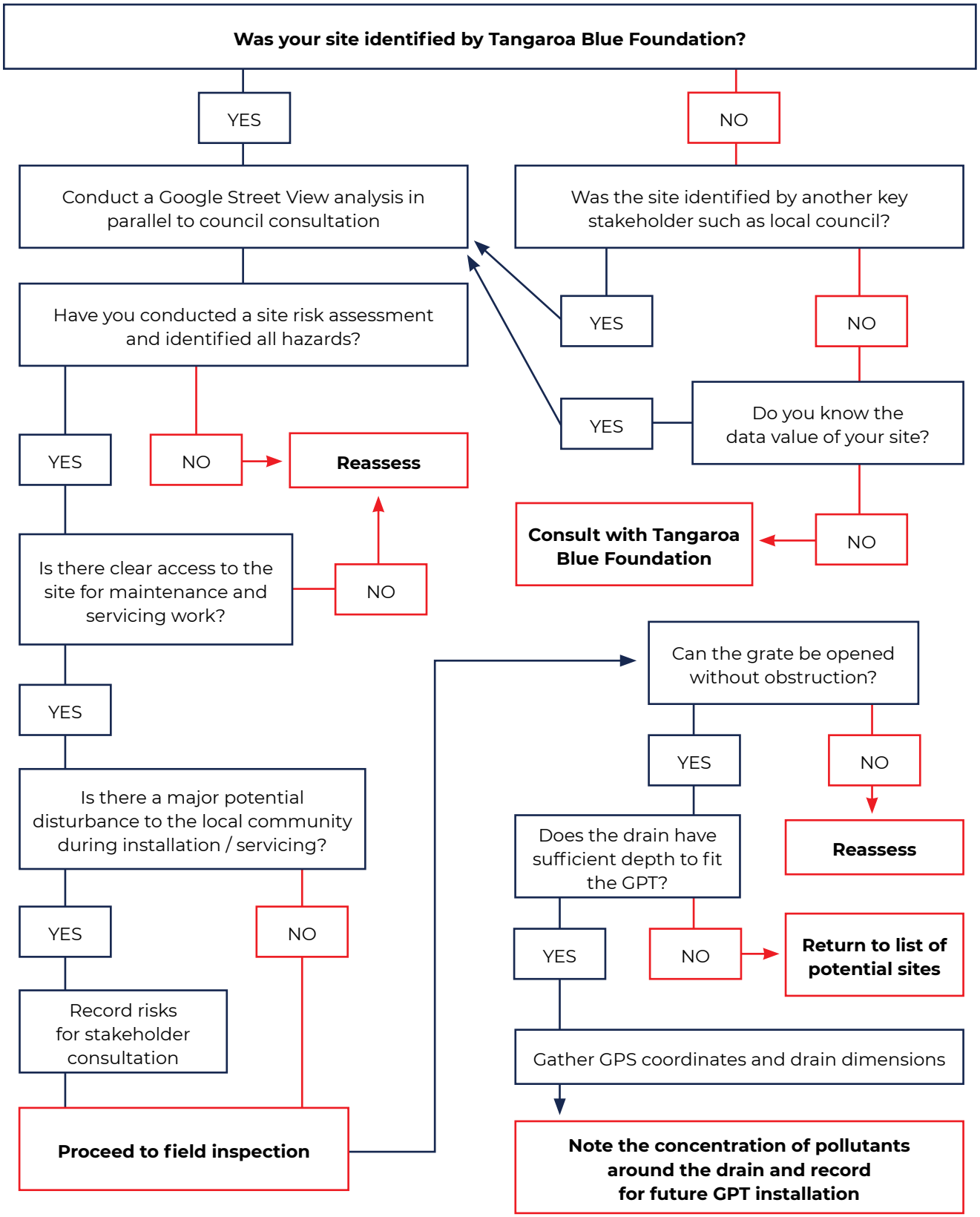
- site access
- site manager's approval
- environmental factors (e.g. don't install your traps under trees, which may shed large quantities of leaf litter).

When selecting specific drains to monitor, identify side entry drains which have clear access and no major potential for disturbance to the local community during installation and servicing. Drains should be able to open easily, without obstruction, and be of sufficient depth to fit whichever gross pollutant trap you plan to use. Distribution of traps should be allocated evenly across land-use zones for even comparison (e.g. five traps allocated per land-use type for each LGA). Wherever possible, consider the litter pathway from the land to ocean. You may be able to place traps along different stages of a catchment, creating a valuable dataset to identify changes in litter types and quantities according to proximity to the ocean.

It is recommended that you work through the GPT Site Selection Tool below with the LGA council or land managers to assist in choosing appropriate trap monitoring sites. If you encounter difficulties during this process, please contact Tangaroa Blue Foundation and we will work with you to develop a monitoring methodology for your area.

GPT SITE SELECTION TOOL

AUSTRALIAN MARINE DEBRIS INITIATIVE



Establishing a baseline

Once you have selected your sites, conduct a background check for any existing information on litter hotspots in your target areas. You can establish your baseline data auditing the litter that is removed when the site is cleaned for the trap to be installed, and by conducting a photographic survey of litter at the drainage outflow. Monitor the immediate areas around a drain outlet pipe to see if there is litter coming out of the drain and into a river, estuary or other natural waterway. Note that your results will be affected by recent weather conditions.

Monitoring drains

Drains should be monitored at 8-week intervals, for six cycles over a year, or as recommended by your asset manager. If you find that one or more of your drains is not accumulating much litter, you can alter its cleaning cycle to another time interval and adjust the accumulation rate accordingly. For example, if you have 100 traps on an 8-week cleaning cycle, but two of these traps are rarely full, reduce the monitoring intervals for those specific traps to every 16 weeks, and then divide the litter collected and counted from those traps by two. This will save you time and servicing costs, whilst still ensuring that you have a comparable dataset across all traps.

Record weather events in your project planning schedule and, if extreme weather is forecast (such as thunderstorms and flooding), empty your traps prior to the weather event if possible.

At each cycle, traps should undergo individual, specialised cleaning, using a fit-for-purpose vacuum system. Record the degree of fullness for each trap as a percentage of fullness from visual observation, and and, if possible, take photos of each trap prior to it being serviced. The material should then be transferred into individual sample bags and transported to a suitable storage site for auditing.

To audit the litter, we recommend coordinating a group of trained volunteers to assist you. Ensure volunteers use a hand rake to separate the contents of a bag before using their gloved hands to sort the litter items in case there are any sharp items hidden by the organic matter. It is also useful to have various sized containers or a sorting tray to help separate the litter into categories for counting. All debris should be classified using the Tangaroa Blue Foundation Marine Debris Identification Manual with data entered into the AMDI Database. Efforts should be made to recycle and re-use separated litter items wherever possible.

Organic litter

Organic litter (e.g., leaf litter or tree bark) should be weighed and included on your data sheet, but recorded separately. This helps to determine the weight of organic materials compared with other kinds of litter. Also note the makeup of the majority of organic matter.

Wet and dry litter

When sorting litter, please note whether the litter collected from each trap is wet or dry. To get a better understanding of the difference in weight between wet and dry litter, keep a sample of 3 to 5 bags of wet litter from across the representative areas, and record the bag weights when the litter is both wet and dry.

5.3 INLAND WATERWAYS MONITORING

Inland waterways include natural freshwater rivers, lakes and creeks. The purpose of an inland waterway survey is to trace litter along its pathway from an on the ground source towards the coast. Prior to arriving at your site, you will need to assess the area using an online mapping tool such as Google Earth, where you can add markers, a polygon and measure distances.

Be mindful of sensitive environments and avoid areas where nesting birds or fragile vegetation may be present. You will also need to consider accessibility and how your site is affected by flood events. In some locations your site may become inaccessible for extended periods of time after heavy rain. If you are unsure about the best location to monitor, please contact Tangaroa Blue Foundation and we will work with you to develop a monitoring methodology for your area.

An inland waterways monitoring uses the following steps:

- Within a 1km section of a waterway you need to identify a surveyable area that can accommodate four 25m transects. Finding a surveyable section measuring 200m in which to set the four transects is the preferred approach, however you may need to adapt the placement of the transects depending on accessibility.
- Place transects randomly within the 200m section.
- Survey and record data.

Equipment required

The equipment required for an inland waterways monitoring includes:

- Tape measure (25m)
- Transect markers
- Litter bags (4 for the transects, plus 1 for additional items found)
- Gloves
- Random number generator (website tool or phone app)
- Data recording sheets and pencil, or the AMDI app (on phone or tablet)
- Knife or scissors
- Sharps container
- Scales
- First aid kit
- Digital camera (optional)
- GPS or location sharing app (what3words or Emergency plus App)

Site selection and assigning starting points

When preparing for monitoring at an inland waterway, you will first need to measure the total length of your site. Your chosen site should have a **maximum length of 1km**. Within this 1km section of a waterway you need to identify a surveyable area that can accommodate four 25m transects. Make sure to note the location of your site using GPS coordinates using the form on page 48.

Setting transects

To ensure a robust dataset and avoid bias towards specific areas, select the place to begin your transects at random. For all subsequent visits, you can return to the same transect starting points again.

To find the place to begin your transects, you will use a random number generator, and each number within your selected range will represent a **one metre** distance from the starting point. You can use a website tool or app, whichever is easiest. For the random number generator, you will need to define an upper and lower limit according to the total length of your waterway. The lower limit will always be 0. To determine the upper limit, take the total length of the area and subtract the length of one transect (i.e. 25m).

When you are on site and ready to measure your first transect, situate yourself at the starting point. Then, use the random number generator to choose the number of metres from the starting point, and commence your first transect at that point. Each transect will be 25m in length (parallel to the water's edge) and allocated randomly across the site. Transects will start at the waterline and extend to the first dense vegetation or the high waterline / floodline. The width of the transect from low waterline to high waterline needs to be measured at the midpoint of each transect.

You will repeat this process another three times, using a random number generator to determine how far from the starting point to commence each transect. If your random number generator produces a number that would result in overlapping transects, choose another random number until there is no overlap. For example, if your first transect commences at 134m from the starting point, and the random number generator produces the number 151m for you to begin your second transect, simply generate another random number until there is no overlap between transects. If the random number generator produces a number that requires you to begin a transect in a location that is inaccessible, move to the closest accessible point from that location and begin your transect there.

In total, you should have 4 randomly selected transects. Transects should only be randomised on your first visit to the monitoring site, and can be repeated for all subsequent visits. Keep your map, measurements and GPS points of where each transect was located on file.

In the example below (Image 5.6), the chosen river length is 400m. In this case, four transects of 25m were placed within one section.

Image 5.6 - Cooks River, Hurlstone Park NSW*.

Example 1 (Image 5.6)

In the example at the Cooks River, NSW our river site was 400m in length. We took the total length of our area (400) and subtracted the length of one transect (25). This gave us a random number upper limit of 375.

On arrival at the site, we randomly generated four numbers from which to begin each transect.

- The first number we generated was 71, so we walked 71 metres from the starting point to place our first transect.
- The second random number we generated was 123, so we walked 123 metres from the starting point and placed our second transect.
- The third random number we selected was 140, however, this overlapped with our second transect, so we generated a new number. This was 264, so we walked 264 metres from the starting point and placed our third transect.
- The fourth random number we generated was 184, so we walked 184 metres from the starting point to set the final transect.

If you cannot find a surveyable section of 200m at your chosen location, you may need to adapt the setup and allocate transects across accessible locations across the 1km range.

Prior to monitoring, note the time of monitoring, wind direction and any recent storm or flood event. Take photographs of each transect area before and after the collection activity, and note the presence of any plastic resin pellets using the Plastic Resin Pellet Rating Tool (p47).

* Image credit: Google Earth

Survey

You can search from a standing or kneeling position, and may extract visible litter from layers such as leaves, sand or soft ground. All debris items greater than 5mm should be removed from the transect area using the AMDI methodology. The litter found in each transect should be placed in its own separate labelled bag. If there is no litter in one or more of your transects, mark as 'zero litter found'. This is still important data, and should be recorded.

If you find an item (for example, a piece of fishing net) that cuts across the transect line, include the entire item.

Record the number of volunteers and time taken during clean-up and sorting. Use an additional bag to collect any debris found outside the transects, which can be recorded separately as a general clean-up in the AMDI Database.

5.4 ESTUARY MONITORING

Estuaries are coastal waterways influenced by tides. The purpose of an estuary survey is to trace litter along its pathway from an on the ground source to the ocean. Prior to arriving at your site, you will need to assess the area using an online mapping tool such as Google Earth, where you can add markers, a polygon and measure distances.

Be mindful of sensitive environments and avoid areas where birds nest or fragile vegetation is present. You will also need to consider accessibility. In some locations your site may become inaccessible for extended periods of time. If you are unsure about the best location to monitor, please contact Tangaroa Blue Foundation and we will work with you to develop a monitoring methodology for your area.

Equipment required

The equipment required for an estuaries monitoring includes:

- Tape measure (25m)
- Transect markers
- Litter bags (4 for the transects, plus 1 for additional items found)
- Gloves
- Gumboots or sturdy boots
- Random number generator (website tool or phone app)
- Data recording sheets and pencil, or the AMDI app (on phone or tablet)
- Knife or scissors
- Sharps container
- Scales
- First aid kit
- Digital camera (optional)
- GPS or location sharing app (what3words or Emergency plus App)

Site selection and assigning starting points

When preparing for monitoring at an estuary, you will first need to measure the length of your site. Your chosen site should have a minimum length of 200m. In the example below (Image 5.8) the estuary length is 400m. Make sure to note the location of your site using GPS coordinates using the form on page 48.

Image 5.8 - Applecross, Perth, Western Australia - this section of estuary measures 400m*.

Setting transects

To ensure a robust dataset and avoid bias towards specific areas, select the place to begin your transects at random. For all subsequent visits, you can return to the same transect starting points again.

To find the points to begin your transects, you will use a random number generator, and each number within your selected range will represent a one metre distance from the starting point. You can use a website tool or app, whichever is easiest. For the random number generator, you will need to define an upper and lower limit according to the total length of your waterway. The lower limit will always be 0. To determine the upper limit, take the total length of the area and subtract the length of one transect (i.e. 25m).

When you are on site and ready to measure your first transect, situate yourself at the starting point. Then, use the random number generator to choose the number of metres from the starting point, and commence your first transect at that point. Each transect will be 25m in length (parallel to the water's edge) and allocated randomly across the site. Transects will start at the waterline and extend to the first dense vegetation or the high waterline / floodline. The width of the transect from low waterline to high waterline needs to be measured at the midpoint of each transect.

You will repeat this process another three times, using a random number generator to determine how far from the starting point to commence each transect. If your random number generator produces a number that would result in overlapping transects, choose another random number until there is no overlap. For example, if your first transect commences at 134m from the starting point, and the random number generator produces the number 151m for you to begin your second transect, simply generate another random number until there is no overlap between transects. If the random number generator produces a number that requires you to begin a transect in a location that is inaccessible, move to the closest accessible point from that location and begin your transect there.

In total, you should have 4 randomly selected transects. Transects should only be randomised on your first visit to the monitoring site, and can be repeated for all subsequent visits. Keep your map, measurements and GPS points of where each transect was located on file.

* Image credit: Google Earth

Example 2 (Image 5.9)

In the example at Applecross, WA our estuary area was 400m in length. We took the total length of our area (400) and subtracted the length of one transect (25). This gave us a random number upper limit of 375.

On arrival at the site, we randomly generated four numbers from which to begin each transect, in a range of 0 to 140m.

- The first number we generated was 12, so we walked 12 metres from the starting point to place our first transect.
- The second random number we generated was 83, so we walked 83 metres from the top of the area and placed our second transect.
- The third random number we selected was 90, however this would overlap with our second transect, so we generated a new number. This was 230, so we walked 230 metres from the starting point and placed our third transect.
- The fourth random number we generated was 301, so we walked 301 metres from the starting point to set the fourth transect.

Image 5.9 - Transects are set at four random distances along the length of the site*

Monitoring should be performed within 3 hours of low tide (90 min either side of the listed low tide) to allow the best possible opportunity to access and collect litter. Prior to monitoring, note the time of monitoring, tide heights, wind direction and any recent storm events. Take photographs of each transect area before and after the collection activity, and note the presence of any plastic resin pellets using the Plastic Resin Pellet Rating Tool (p47).

* Image credit: Google Earth

Survey

You can search from a standing or kneeling position, and may extract visible litter from layers such as leaves, sand or soft ground if required to remove litter. For each transect section, all debris items greater than 5mm should be removed from the transect area using the AMDI methodology. The litter found in each transect should be placed in its own separate, labelled bag. If there is no litter in one or more of your transects, mark as 'zero litter found'. This is still valuable data, and should be recorded.

If you find an item (for example, a piece of fishing net) that cuts across the transect line, include the entire item.

Record the number of volunteers and time taken during clean-up and sorting. Use an additional bag to collect any debris found outside the transects, which can be recorded separately as a general clean-up in the AMDI Database.

5.5 COASTAL SHORELINE MONITORING

Coastal shorelines include sandy beaches, rocky shores and other types of beaches (pebbles, mud etc.).

The purpose of a coastal shoreline survey is to trace the source of litter entering into or emerging from the ocean. Prior to arriving at your site, you will need to assess the area using an online mapping tool such as Google Earth, where you can add markers, a polygon and measure distances.

Be mindful of sensitive environments and avoid areas where nesting birds or fragile vegetation may be present (for example, dunes). You will also need to consider accessibility. In some locations your site may become inaccessible for extended periods of time, due to changes in tides and the shape of the beach across seasons. If you are unsure about the best location to monitor, please contact Tangaroa Blue Foundation and we will work with you to develop a monitoring methodology for your area.

Equipment required

The equipment required for a coastal shoreline monitoring includes:

- Tape measure (25m)
- Transect markers
- Litter bags (4 for the transects, plus 1 for additional items found)
- Gloves
- Random number generator (website tool or phone app)
- Data recording sheets and pencil, or the AMDI app (on phone or tablet)
- Knife or scissors
- Sharps container
- Scales
- First aid kit
- Digital camera (optional)
- GPS or location sharing app (what3words or Emergency plus App)

Assign starting points

When preparing for monitoring on a coastal shoreline, you will first need to measure the distance of your site. Your chosen site should have a minimum length of 250m. In the example below (Image 5.10) the chosen beach area is 400m long. Make sure to note the location of your site using GPS coordinates using the form on page 48.

Image 5.10 - Fingal Bay, NSW - This section of beach is 400m*.

Setting transects

To ensure a robust dataset and avoid bias towards specific areas, select the place to begin your transects at random. For all subsequent visits, you can return to the same transect starting points again.

To find the points to begin your transects, you will use a random number generator, and each number within your selected range will represent a one metre distance from the starting point. You can use a website tool or app, whichever is easiest. For the random number generator, you will need to define an upper and lower limit according to the total length of your waterway. The lower limit will always be 0. To determine the upper limit, take the total length of the area and subtract the length of one transect (i.e. 25m).

When you are on site and ready to measure your first transect, situate yourself at the starting point. Then, use the random number generator to choose the number of metres from the starting point, and commence your first transect at that point. Each transect will be 25m in length (parallel to the water's edge) and allocated randomly across the site. Transects will start at the waterline and extend to the first dense vegetation or the high waterline / floodline. The width of the transect from low waterline to high waterline needs to be measured at the midpoint of each transect. If this is not feasible, make sure that the transect extends to 10m on either side of the high tide line.

You will repeat this process another three times, using a random number generator to determine how far from the starting point to commence each transect. If your random number generator produces a number that would result in overlapping transects, choose another random number until there is no overlap. For example, if your first transect commences at 134m from the starting point, and the random number generator produces the number 151m for you to begin your second transect, simply generate another random number until there is no overlap between transects. If the random number generator produces a number that requires you to begin a transect in a location that is inaccessible, move to the closest accessible point from that location and begin your transect there.

In total, you should have 4 randomly selected transects. Transects should only be randomised on your first visit to the monitoring site, and can be repeated for all subsequent visits. Keep your map, measurements and GPS points of where each transect was located on file.

* Image credit: Google Earth

Example 3 (Image 5.11)

In the example at Fingal Bay, NSW our beach area was 400m in length. We took the total length of our area (400) and subtracted the length of one transect (25). This gave us a random number upper limit of 375.

On arrival at the site, we randomly generated four numbers from which to begin each transect, in a range of 0 to 375m.

- The first number we generated was 35, so we walked 35 metres from the starting point to place our first transect.
- The second random number we generated was 160, so we walked 160m from the starting point and placed our second transect.
- The third random number we selected was 28, however this would overlap with our first transect, so we generated a new number. This was 226, so we walked 226 metres from the starting point and placed our third transect.
- The fourth random number we generated was 347, so we walked 347 metres from the starting point to set the fourth transect.

Image 5.11 - Transects are set at four random distances along the length of the site*.

Monitoring should be performed within 3 hours on either side of low tide to allow the best possible opportunity to access and collect available litter. Prior to monitoring, note the exact transect location (start and endpoints) using GPS (p49). The time of monitoring, tide heights, wind direction and any recent storm events should also be recorded. Take photographs of each transect area before and after the collection activity.

Note the presence of any plastic resin pellets using the Plastic Resin Pellet Rating Tool (p47). In each transect you can use a random number generator to select a place along the high tide line to place a quadrant for microplastic monitoring. The quadrant should be 50cm x 50cm in size and the surface should be scrapped to a depth of 2cm from the surface and sieved for microplastics. Data should be collected using the AUSMAP methodology.

* Image credit: Google Earth

Survey

You can search from a standing or kneeling position, and may extract visible litter from layers such as leaves, sand or soft ground if required to remove litter. For each transect section, all debris items greater than 5mm should be removed from the transect area using the AMDI methodology. The litter found in each transect should be placed in its own separate, labelled bag. If there is no litter in one or more of your transects, mark as 'zero litter found'. This is still valuable data, and should be recorded.

If you find an item (for example, a piece of fishing net) that cuts across the transect line, include the entire item.

Record the number of volunteers and time taken during clean-up and sorting. Use an additional bag to collect any debris found outside the transects, which can be recorded as a general clean-up in the AMDI Database.

5.6 UNDERWATER MONITORING

Underwater monitoring activities will follow the methodology created by the *Underwater Volunteers NSW* [1].

Safety is the number one priority in underwater monitoring. Underwater surveys conducted by scuba or freediving should only be conducted by competent divers with the necessary qualifications and experience, and always with a partner. There should always be someone on the shore or boat to act as safety support. Consideration should be made of tides and the conditions on the day to ensure that dives are conducted safely.

Before removing an item of marine debris, consider if it belongs in the environment, whether it has become a habitat for animals, or is threatening the health of the marine ecosystem. Any item that is likely to cause harm into the future should be removed, if it is safe to do so. Do not remove anything unless you can do so safely, being mindful of sharp edges and rusty items. If it is not safe to remove a hazardous item, mark its position and arrange for its removal if possible. Carry line cutters, so that if you encounter fishing line or rope entangled around marine life, or on the reef substrate, you can cut and remove the line in sections. It is also advised to carry a rigid container to store any sharp objects found.

The following steps are taken in underwater monitoring:

- Identify sites and assign the type of seabed.
- Prepare a dive plan, which includes identifying a random starting point and transect depth.
- Set transects, either from a boat or shoreline.
- Collect and record litter.

Equipment required

The equipment required for an underwater monitoring includes:

- SCUBA / dive equipment (as required)
- Tape measure (25m)
- Rigid container for sharp items
- Mesh carry bags (4 for the transects, plus 1 for additional items found)
- Knife, scissors or line cutters
- Compass
- Underwater camera (optional)
- Data recording sheets and pencil, or the AMDI app (on phone or tablet)
- First aid kit.
- GPS or location sharing app (what3words or Emergency plus App)

[1] *The original methodology used for this protocol can be sourced at:*

Smith, S.D. and Edgar, R.J. A Standardised Protocol for Assessing Marine Debris in NSW Waters, National Marine Science Centre, Southern Cross University, https://uvnsw.net.au/media/uvnsw/Marine-Debris-Protocol_0.pdf

Site selection

Underwater monitoring will depend on factors including the type of site, size of the habitat patch, and whether you are completing a shore dive or boat dive. Underwater monitoring should be conducted over a specific seabed or reef type, which may include sandy bottoms, rocky reef, coral reef or kelp forest. If a site contains more than one type of seabed, separate transects should be performed per seabed type.

Identify the type of seabed that you will be targeting, and prepare a dive plan accordingly, noting the depth of water across the site area.

Setting transects

You will set four transects of 25m (length) x 5m (width), with a total survey area of 500m^2. To ensure a robust dataset and avoid bias towards specific areas, all transects should be set at random starting points and wherever possible following a continuous habitat. The transect line does not have to be straight, it can bend around reef structures.

Diving from a boat

Starting at a random point in the open water, four 25m x 5m transects are deployed at radial intervals of 90 degrees. Viewed from above, the transects would radiate out from a central point in the shape of a cross at least 10m apart.

Image 5.12 - Transects are set at 90 degree intervals around the boat, forming a cross shape*.

* Image credit: Google Earth

In the case of smaller or fragmented habitats (e.g. a reef intersected by sand) transects may be allocated across the available habitat at least 10m apart.

Image 5.13 - Transects are allocated across the reef to ensure a consistent seabed type*.

Diving from the shore

Starting at the shore, four transects of 25m x 5m can be set either parallel or perpendicular to the shoreline. Transects should be set from a random starting point, at least 10m apart.

Transects running parallel to the shore are useful in cases where the seafloor has a significant slope.

Image 5.14 - Transects run parallel to shoreline to maintain a consistent depth*.

* Image credit: Google Earth

Transects running perpendicular to the shore are useful, for example, when monitoring marine debris along a breakwall.

Image 5.15 - Port Macquarie, NSW - Transects run perpendicular to the shoreline*.

Survey

Debris should be removed from a corridor of approximately 2.5m wide on either side of a tape measure marking the transect length of 25m. Transects should be completed in pairs swimming side by side along the tape measure. Divers should swim slowly, checking under overhangs and in cracks and crevices and looking back regularly from the direction travelled to gain a different search perspective. While divers should always practice good buoyancy control to minimise impact on marine organisms, being too far above the substratum will limit the ability to detect debris.

Collect debris in a mesh bag that will hold items 5mm or greater in size. Place any sharp objects inside a rigid container to avoid injury. Larger items may be used as habitat, in which case they should be noted and photographed (where possible) but not removed. If there is no litter found within the transect mark it as 'zero litter found', as this is still valuable data. After completing the four transects an additional roaming search (up to 30 minutes) should be conducted to provide a more complete picture of the debris load at the site. These items should be recorded separately as a general clean-up in the AMDI Database.

When you or your dive partner has 50 bar of air remaining in your scuba cylinder, both divers must begin a slow ascent and perform a 3-minute safety stop at 5 metres. Plan your dive in this context, for example, plan to have 50 bar remaining after the transect line has been retrieved, rather than starting to retrieve the line when you have 50 bar remaining.

If working in coral dominated habitat minimise direct contact with coral and take care not to break off coral when untangling debris.

When dealing with nets, constantly observe the movement of the net in water surges to avoid entanglement of yourself or your gear. Where nets are severely entangled, they can be cut in sections or noted for later removal.

* Image credit: Google Earth

6. Data Collection and Sorting

What data should I collect?

For monitoring purposes, every item larger than 5mm is counted and classified, noting the specific transect, asset or section as dictated by the methodology. If you do not find any litter, note down that nothing was found - this is just as important as if you found items. Do not add additional monitoring points to your site for litter found in adjacent areas as this will bias the results. Additional areas cleaned outside the monitoring areas should be recorded as a separate general clean-up in the AMDI Database.

Sorting, counting and data recording

Sort your data as soon as possible following the collection activity. When sorting through the litter, you should find a site that is out of the wind so that items such as food wrappers and paper do not blow away. If you sort and count outdoors, make sure you have an appropriate disposal strategy. If you take the debris home to sort and count, make sure to write the site name, date and transect number on the bags, and secure the tops. If you are counting the debris at a later time, store the bags in a safe place, where children, pets and weather cannot get to them.

Equipment you may need for sorting and counting:

- Marine Debris Identification Manual
- project specific data sheets provided by AMDI or data entry device
- Small tarp and various containers to assist in separating items – especially if you are counting the debris at the clean-up location
- tape measure – for measuring items such as rope and plastic strapping bands
- digital camera – if available - to record an image of the debris once sorted. The site name can be noted with the debris for identification of the site in the photo
- gloves
- sharps container
- dustpan and broom.

Data records

The Tangaroa Blue Foundation website has several data forms that can be downloaded , however it may be necessary to personalise these to your project and you may be able to directly input the data into the AMDI App.

Additional datasets information

In addition to tallying the number of items found during monitoring events, some items can be better traced to the source if additional information is collected. These include:

Chemical light stick / Glow stick	Chemical light sticks / glow sticks are located in the "Plastic Items - Fishing" section of the AMDI Database. Record how many of each type of chemical light stick / glow stick you find. Types can be identified on pages 42-45 of the AMDI Marine Debris Identification Manual 2021.

Strapping bands	Record the colour, width, length, whether the band is cut or uncut and any writing on the band.
Tags	Record what material tags are made from, colour and all writing and numbers.
Foam buoys	Foam floats often have an identification number stamped on them. Record this in the notes column next to your foam buoys entry.
Foreign sourced objects	When you find an item with a label indicating an overseas origin and can decipher some or all the following details, record the type of item, country of origin, brand name, product name and barcode.
Plastic resin pellets	These are pictured in the "Plastic Items - Industrial, Commercial, Shipping & Miscellaneous" section. If you observe plastic resin pellets during your clean-up record a 'yes' in the additional information section at the end of your data entry and whether found in low, moderate or high numbers.
Micro-litter	If you notice other types of micro-litter (items less than 5mm in size) including microplastics, rubber crumb, polystyrene balls or glass shards, please make a note at the end of your data entry and whether found in low, moderate or high numbers.
Unusual beach conditions	If you notice out of the ordinary erosion or exceptional swell conditions make a brief note in the additional information section.
Impacted wildlife	During your surveys you may come across animals that are impacted by either entanglement or ingestion of marine debris. These are important observations that provide information for researchers investigating the scale of litter and marine debris impacts on wildlife. Report injured wildlife to your local ranger, land manager or in the case of seabirds to an available local group such as Australian Seabird Rescue. http://www.seabirdrescue.org
Ghost nets	Ghost nets pose significant danger to marine wildlife and safety issues to vessels through entanglement. Studies into the types and sources of nets are important for addressing the activities and impacts not only on marine animals and ecosystems but the economies of fisheries. Reference the Ghostnets Australia ID Guide: https://www.ghostnets.com.au/resources/net-id-guide/

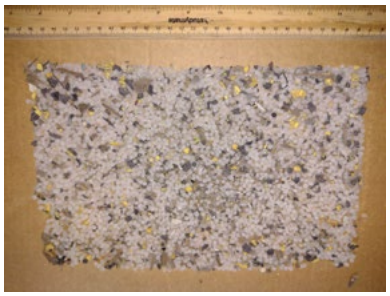
Please refer to the AMDI Marine Debris Identification Manual for recording and sampling these items.

Subsampling

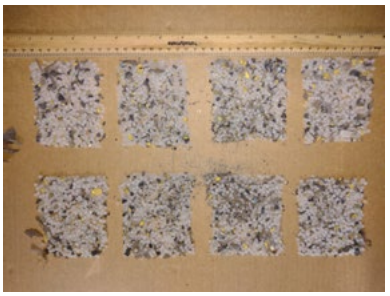
In the case that you find a large number of small items, such as confetti or polystyrene balls, you can take a subsample of the item. First remove any macro-litter items and then make a square from your micro-litter items on a table, ensuring an even spread and thickness of litter items. Divide your square into segments, and then randomly select and count just one of these segments. Multiply the total number you count by the number of segments in your square.

Example

Collect your pile of small items.



Set out into a single layer square or rectangle, then divide in smaller segments.



Count one of the segments, then multiply the number by 8 to get the total.

Microplastic assessment

Microplastics are tiny fragments, pellets or fibres of plastics with a size of ≤ 5 mm. Most of them are smaller than a grain of sand and invisible to the naked eye. They are the most abundant form of solid-waste litter and marine debris and have been found in all oceans, on all continents and even in the deep sea where their concentration is now four times higher than in coastal waters. Microplastic surveys may be carried out to maximise opportunities to fill data gaps. Surveys should be carried out where the location lends itself to sampling (i.e. soft sediment) and where there is capacity beyond your meso and macro-litter monitoring activities.

Disposal of debris

Most non-recyclable debris in small quantities can be disposed of in the rubbish bin, however there are some important points to consider when disposing of debris. To check what can be recycled in your area, contact your local government authority. When placing items in the recycling system, make sure they are relatively clean, uncontaminated and not encrusted with barnacles. If you find you need to dispose of a large quantity of debris, your local government authority may be prepared to assist, but it is best to contact them prior to the event to allow enough time for arrangements to be made.

Toxic or hazardous items (fluorescent light bulbs, chemical light sticks, paint, flammable materials, syringes, etc.) should be handled according to health and safety guidelines, and disposed of in accordance with local government regulations.

7. Entering Data into the AMDI Database

We have helpful videos on the Tangaroa Blue Foundation Youtube playlist How to use the AMDI Database that demonstrate how to enter datasets into the AMDI Database. However, entering monitoring data requires specific training to ensure that your data is accurately recorded and any additional layers of information are accurately attributed. For this you will need to schedule a data entry training session. Contact data@tangaroablue.org to find out about available training dates.

Reports and data access

When your data is uploaded, the AMDI data team will provide you with downloads of your data. Your report will include an excel spreadsheet that you can use to complete reporting. Please ensure that when you register your project site that your reporting timelines are scheduled with our data team. Our privacy and data collection statements are available on our website. https://www.tangaroablue.org/database/.

Technical support

The AMDI team can offer you technical support, including assistance with site identification and mapping, scheduling, event promotion, equipment supply, uploading data, and providing letters of support. Please contact us for more information at info@tangaroablue.org.

8. References

Borelle, S.B. et al. 2020 'Predicted growth in plastic waste exceeds efforts to mitigate plastic pollution' Science 369 (6510), 1515-1518.

Commonwealth Scientific and Industrial Research Organisation. (1999). Urban stormwater: best practice environmental management guidelines. ISBN 0 6430453 2. Collingwood VIC: CSIRO Publishing.

CSIRO Handbook of Survey Methodology Plastics Leakage (developed for CSIRO Global Plastic Pollution Baseline Project) (2020)

Forrest, A. et al. 2019 ' Eliminating Plastic Pollution: How a Voluntary Contribution From Industry Will Drive the Circular Plastics Economy. Front. Mar. Sci. 6:627.

Freitag, Amy, Ryan Meyer, and Liz Whiteman. "Strategies employed by citizen science programs to increase the credibility of their data." Citizen Science: Theory and Practice 1.1 (2016).

Gunn, J. and Barker, G. (2009). Water Quality Pollutant Types and Sources Report: Black Ross Water Quality Improvement Plan. Townsville: Townsville City Council/Creek to Coral.

Hardesty, et al. (2016). Understanding debris sources and transport from the coastal margin to the ocean. CSIRO: EP165651.

J. Hill and J. Loder (2013). Reef Check Australia Survey Methods. Reef Check Foundation Ltd. http://www.reefcheckaustralia.org/files/documents/44/rca_monitoring_methods.pdf

Jambeck, J.R. et al., 2015, 'Plastic waste inputs from land into the ocean', Science, Vol. 347, No. 6223, pp.768-771.

National Geographic Society. (2019). Encyclopedic Entry: Citizen science. Available Online: https://www.nationalgeographic.org/encyclopedia/citizen-science/

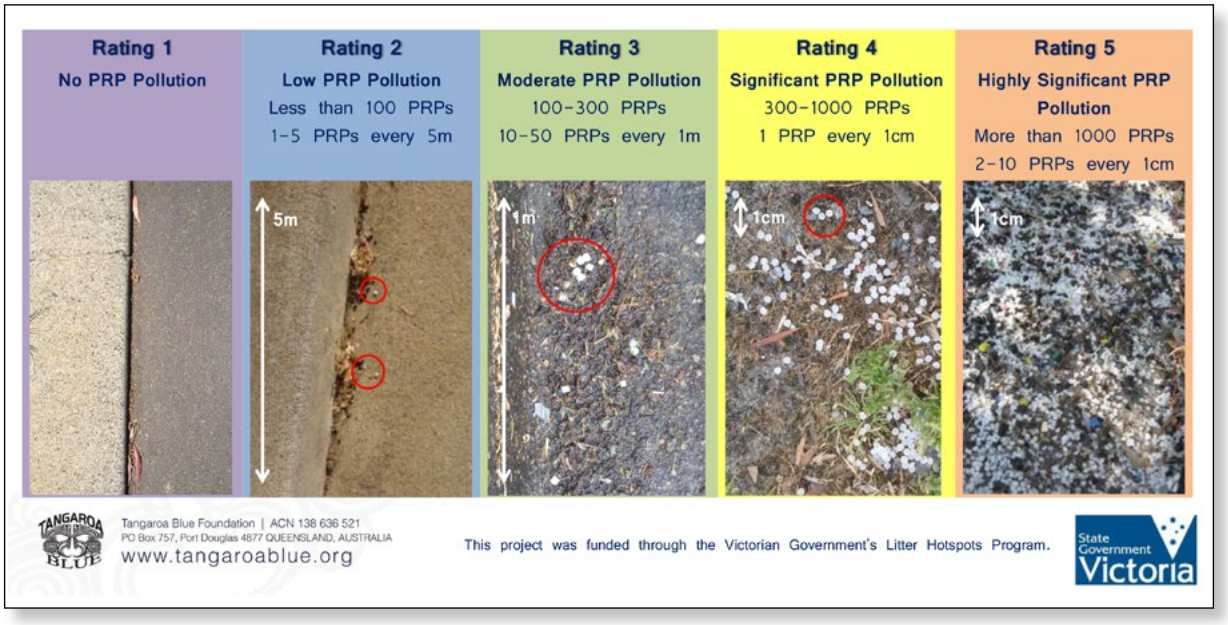
National Oceanic & Atmospheric Agency. (2018). Marine Debris: What Is Marine Debris?. Available Online: https://marinedebris.noaa.gov/posters-and-factsheets

Smith SD & Edgar R.J. (2014) Documenting the density of subtidal marine debris across multiple marine and coastal habitats. PLoS ONE. 9(4):e94593. doi: 10.1371/journal.pone.0094593. eCollection 2014

Tangaroa Blue Foundation. Marine Debris Identification Manual 2021. Available Online: https://www.tangaroablue.org/download/30/id-manual/9813/marine-debris-identification-manual.pdf

9. Resources

Plastic resin pellet (PRP) litter rating tool



Wildlife impact observation sheet

Date	
Site details / Address	
Latitude/Longitude	
Species common name	
Dead / injured/ entangled	
Injury/entanglement information	
Reported to	

Injured and entangled wildlife should be reported to the governing wildlife authority in the area.

Survey GPS marks or What 3 Words data (Emergency Plus App)

Transect start mark / W3W	Area Type	Latitude	Longitude
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
Other			

PROJECT SITE REGISTRATION FORM

AUSTRALIAN
MARINE DEBRIS INITIATIVE

ORGANISATION AND CONTACT DETAILS		
Organisation/ community group name(s) include all entities and individuals		
Contact person		
Contact details	Email	
	Phone	
	Address	
	Role	
	Best contact times	
Start date of monitoring program		
End date of monitoring program		
Reporting requirements data downloads required, attach schedule if known.		
Frequency of monitoring. Daily, weekly, Monthly, Quarterly ect		
Type of monitoring activity		
Project Name		
Site Name (Please include traditional landowner names)		
Traditional Landowner Group		
Landowner (private, local government, state government, business		
Location: Address, GPS points, What 3 Words, etc		
Do you require support? Please provide information of your needs		

MONITORING SECTOR	
SECTOR	**DESCRIPTION**
On the Ground	
Built Drainage	
Inland Waterway	
Estuary	
Coastal Shoreline	
Underwater	

LOCATION FEATURES	
Adjacent land usage. e.g., shops, beaches, housing, sporting fields, recreational parklands, industrial area	
Describe civil infrastructure information, stormwater outlets, drains, bridges, boat ramps, roadways	
Area Dimensions	
Is the area maintained regularly? By which authority	
What amenities are in the boundary of your survey area? Playgrounds, picnic tables, toilet blocks	
Is the area well maintained and by which authority. What maintenance e.g. mowing and do you know when?	
Access points. Please describe how users access this site, how many entry points and types eg pedestrian, pathway, trail, vehicle	

WASTE DISPOSAL	
How many bins in the area?	
Are waste disposal assets easily accessible, identifiable?	
Are waste disposal assets fit for use and prevent litter from escaping?	
Any other information about your area	

AREA MAP - GENERATE AN AREA MAP AND COPY ATTACH INTO THIS FORM

HUMAN INFLUENCES	
Who uses the area?	
What is the area used for?	
When is the area used? (daily, weekly)	
Are events like markets, concerts held in or adjacent to the area?	
What activities occur in the surrounding areas?. Industry, cafes	
Other information	

WHY HAVE YOU CHOSEN THIS SITE FOR MONITORING PURPOSES	
I see litter regularly in this area and want to work at stopping this from happening	
Governing authority target area	
Source reduction target items	
Gather data for attention of authority	
Concern for welfare of wildlife and environment	
Other	

OUTCOMES OF MONITORING	
Who is reviewing your data?	
What is the purpose of your data?	
When	
Where	
Time frame	
What are your goals? Prompts could include producing baseline data set to prove xxx is coming from yyy. Create awareness for a specific pollution issue	

AMDI ADMINISTRATION		
Project Code		
Mapping status		
Data audits		
Services provided		
In-kind		Hrs
Project fee		Hrs
Accepted		By / date

amdi.tangaroablue.org