

Case Study “Environmental change and management of the coastal environment”

Activity Sheet 7 “Plastics in Port Phillip Bay”

Introduction

This set of activities analyses the amount, composition and distribution of plastic waste in Port Phillip Bay. It provides students with the understanding that plastics in our waterways, such as Port Phillip Bay, whilst not of the same scale as the great Pacific Garbage Patch, is still a significant and growing problem. This content can be used as a local case study or combined with a fieldwork trip about plastics in Port Phillip Bay. If you are planning to use this case study as a fieldwork trip it is highly recommended that you look at the fieldwork activities that [Port Phillip Baykeeper](#) and [Polperro Dolphin Swims](#) offer. These can be found in the Fieldwork Activities section of this site.

The content of this activity sheet relates to the following Geographical Concepts and Skills and Geographic Knowledge:

Geographic Concepts and Skills

Place, Space and Interconnection

- Identify, analyse and explain significant distributions and patterns and identify and evaluate their implications over time and at different scales.
- Identify, analyse and explain significant interconnections within places and between places over time and at different scales and evaluate the resulting changes and further consequences.

Data and Information

- Collect and record relevant geographical data and information, using ethical protocols, from reliable and useful primary and secondary sources.
- Select, organise and represent data and information in different forms, including by constructing special purpose maps that conform to cartographic conventions, using digital and spatial technologies as appropriate.
- Analyse and evaluate data, maps and other geographical information using digital and spatial technologies and Geographical Information Systems as appropriate, to develop identifications, descriptions, explanations and conclusions that use geographical terminology.

Geographic Knowledge

- Environmental, economic and technological factors that influence environmental change and human responses to its management.
- Causes and consequences of an environmental change, comparing examples from Australia and at least one other country.

Port Phillip Bay- Background Information

1. Base map of Port Phillip Bay.

A suitable map for the tasks in this activity sheet can be found at [Melbourne Suburbs Map](#) or look at [Snazzy Maps](#).

Using appropriate geographic conventions mark in the location of the following features:

- Melbourne CBD
- Geelong
- Yarra River, Maribyrnong, Werribee, Patterson and Little Rivers.
- Kananook, Mordialloc, Sweetwater, Cowies, Chinamans and Koroit Creeks

2. Summarise the key geographical characteristics and their descriptions of Port Phillip Bay in the table below. In your description make note of the reasons why Port Phillip Bay is an environmentally significant resource. Some useful sites include:

- [Yarra and Bay](#). This site has a large amount of quick and accessible information.
- [Beautiful Altona](#)
- [Port Phillip Bay and Westernport](#)
- [Parks Victoria](#)
- [Port Phillip Bay Environmental Management Plan 2017-2027](#) (see section titled “ supporting document”)

Geographic Characteristic	Key Facts
Relative Location	
Size	
Topography	
Geological Formation	
River Systems	
Flora	
Fauna	

Climate	
Population size and distribution	
Key economic activities	
Main human modifications	

The amount, composition and source of plastics entering Port Phillip Bay

A recently released report by the Port Phillip EcoCentre titled “Microplastics in the Maribyrnong and Yarra Rivers, Melbourne, Australia” is an excellent resource discussing the amount, composition and source of plastics entering Port Phillip Bay. The key findings of this report are “In total, over 828 million litter items flow into Port Phillip Bay annually from the two rivers (Yarra and Maribyrnong). Over 612 million (74%) of these items are microplastics. In both rivers, most of the litter caught consisted of hard plastic remains of broken up plastic items. Of the other researched items polystyrene, nurdles and plastic bottle caps were most problematic in the Yarra, while in the Maribyrnong, plastic straws and soft plastics were more prevalent” (page 1)

A full copy of this report can be found at <http://www.ecocentre.com/cleanbayblueprint>. The following questions and tasks are based on the content contained in this report.

1. Download and discuss a map similar to that shown below showing the catchment areas of the main rivers entering Port Phillip Bay. (the emphasis will be placed on the Yarra and Maribyrnong Rivers)

Catchment areas surrounding Port Phillip Bay



Image taken from: <https://www.melbournewater.com.au/about-us/services-and-prices/waterways-and-drainage-charge>

- Refresh students' knowledge of the basic concepts involved in a drainage basin
- If your students live in any of the catchment zones shown above, using Google Earth, ask them to find their address. Assuming a plastic bottle cap is left in the gutter near their house get students to follow the path this cap may take until it reaches the bay. Using the above activity as an example, discuss with students that the source of plastics entering Port Phillip Bay could come from any location in the above catchments. According to the report "Microplastics in the Maribyrnong and Yarra Rivers, Melbourne, Australia" most plastic pollution in Port Phillip Bay originates from land-based sources and enters the oceans through storm water drains, waste water treatment plants and river runoff" (page 6)

- To obtain background details about the key rivers entering Port Phillip complete a simple table, such as that shown below, listing the key features of the Maribyrnong and Yarra Rivers.

Characteristic	Maribyrnong River	Yarra River
Location of head of river		
Length (in kms)		
Main tributaries		
Catchment size		
Path of river		
General use of land in catchment area		
Population in catchment area		

Some useful sites to obtain this information include:

[Yarra and Bay](#)

[Melbourne Water](#)

[Parks Victoria](#) (go to Visitor Information to obtain key information about this river.)

If you wish you could also look at the health of the Yarra and Maribyrnong Rivers by looking at the information under “report card” at the Yarra and Bay website. Discuss with students what happens to the health of the river the further you travel downstream.

2. Read over and discuss the report “Microplastics in the Maribyrnong and Yarra Rivers, Melbourne, Australia” available at <http://www.ecocentre.com/cleanbayblueprint> and answer the following questions:

- Outline the methods used to collect data regarding the quantity and composition of plastics found in the Maribyrnong and Yarra Rivers (pages 9-12)
- What was the total number of litter items found in the Yarra and Maribyrnong Rivers during the testing period? Based on the data collected what is the estimate of the total amount of litter items per river? Why could this final figure be an underestimation of the total litter items? (page 13 and page 23)
- What has happened to the amount of litter items in the Maribyrnong and Yarra Rivers over time? (page 21)
- What were the most common plastic items found? (page 14)

- e. Refer to Figures 5 and 6 on page 14 and 15 of this report. For both the Maribyrnong and Yarra Rivers describe the main types of litter found. Note the similarities and differences between the two rivers. (pages 14-18)
Suggest factors that could explain these trends (page 24).
- f. Refer to Figures 10 and 11 on pages 19 -20 of this report. Describe the seasonal differences in the amount and composition of plastics in the two rivers. Hypothesise about factors that could explain these results (page 24).

Some students may find it easier to record the information in a table format, as shown below.

	Yarra River	Maribyrnong River
Number of plastic litter items found		
Change in the number of plastic litter items found over time		
Most common types of plastic items found		
Seasonal variations in the number of plastic items found		

It may be also useful to personalise the statistics contained in this report. For example, if you have access to some microplastics show the class what 100 pieces would actually look like. To take this a step further, tip these into a large container or a fish tank containing water.

The distribution of plastics Port Phillip Bay beaches

The following data exercise provides an indicator of the distribution of plastic litter in Port Phillip Bay. Before proceeding with this exercise it is important to acknowledge the limitations of using this data. These include:

- The statistics include all litter items found. Whilst the majority of these tend to be plastics other non-plastic items could be included.
- Not all areas/beaches in Port Phillip Bay have data available. In this case data is available for a number of eastern beaches of Port Phillip Bay, but very few western beaches of Port Phillip Bay have available data.

- The statistics were obtained by picking up litter on beaches and the surrounding environment that has floated and washed ashore. It does not include plastics that are submerged or are floating in the middle of the bay.
- The data is based on volunteers picking up rubbish. Consequently, we need to take into account the direct relationship between the number of volunteers and the amount of litter collected. We also need to recognise that the expertise of volunteers may also vary.
- The data available could be impacted by a number of variables such as the efficiency of council's street cleaning, the timing of such cleaning/litter collection and seasonal variations such as holiday periods.

As such, the data can only be used as an indicator and provide a useful source of discussion about the distribution of plastics in Port Phillip Bay and the reasons that may account for this distribution.

Steps

1. Go to the [Beach Patrol](#) website.
2. Look at the data for each of the beaches.
3. Enter the data in on a table similar to that below. When completing the calculations include data from both 2018 and previous years.

Location	Kilograms of litter collected	Volunteer Hours	Kgs of litter collected per volunteer hour	Common items collected	Quantity of nurdles found
Albert Park					
Elwood					
Brighton					
Sandringham					
Ricketts Point					
Parkdale					
Chelsea					
Rye					
Frankston					
Mordialloc					
Tootgarook					

Mt Eliza					
Carrum					
Port Melbourne					
St Kilda					
South Melbourne					
Mentone					
Hampton					
Aspendale					
Williamstown					
Seaford					
Werribee					
Altona					
Dromana					
Rosebud					

3. Complete a choropleth map showing the kilograms of litter collected per volunteer hour on the initial base map created. Prior to commencing this map agree on a suitable legend. For example:

- 1 < 2 kilograms of litter per volunteer hour
- 2 < 3 kilograms of litter per volunteer hour
- 3 < 4 kilograms of litter per volunteer hour
- > 4 kilograms of litter per volunteer hour

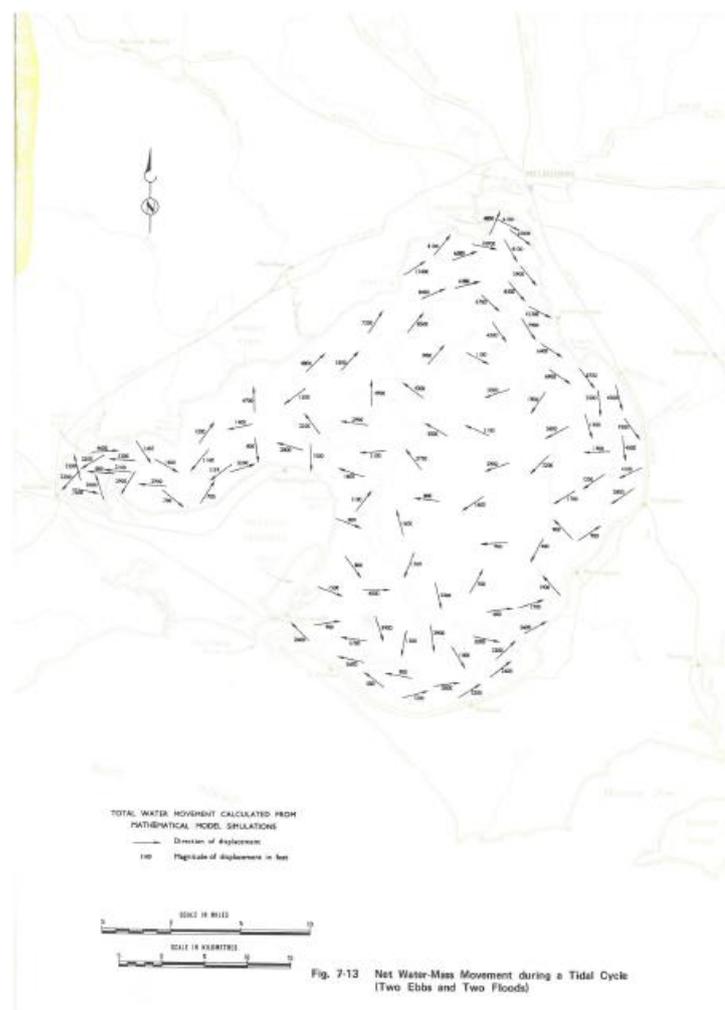
Remember to complete this map using the correct geographic conventions.

Please note that not all of the above locations will appear on a suburbs map. If you wish for all sites to be included then an alternative to the above is to show the location of each of the sites by a number key, with each number circled. Each of these numbers could then be shaded to show the kilograms of litter per volunteer hour.

4. With reference to the data contained on the map describe the distribution of litter collected per volunteer hour.

5. As a class hypothesise about the factors (e.g. prevailing winds, shape of the coastline, main channels/currents in Port Phillip Bay, location of rivers/creeks, surrounding land use) that could explain the distribution pattern and then complete the following tasks:

- a. Describe the spatial association between the proximity to Melbourne's C.B.D and amount of litter collected per volunteer hour.
- b. Complete research to ascertain the prevailing wind direction in Port Phillip Bay. Using an appropriate key mark this on your base map. Describe the spatial interaction between wind direction and the amount of litter collected per volunteer hour.
- c. Referring to the content on your base map describe the spatial association between river/creek entrances and the amount of litter collected per volunteer hour.
- d. List the areas that have the highest amount of litter collected per volunteer hour. Research these areas to establish what may be the factors behind this result. You could consider factors such as
 - The surrounding land use (e.g. does the area have heavy beach usage by visitors or is it near an industrial area?)
 - Whether the sites are near main roads
 - The location of the main currents/channels in Port Phillip Bay (refer to the map below)



e. Based on their findings from the above tasks get students to write a brief report about the distribution of litter in Port Phillip Bay and the factors that could account for this pattern.

Please remember that the tasks on this activity sheet can be used in conjunction with a fieldwork trip and consequently the content obtained can be included in the student's fieldwork report. If this is the case you may wish to alter the above tasks to suit your research question and hypothesis.

To obtain primary data it is highly recommended that you look at the fieldwork activities that Baykeeper and Polperro can offer. These are found in the Fieldwork Activities section of this site. If you intend to undertake litter surveys whilst out in the field you are strongly encouraged to contact Baykeeper, so that these surveys are co-ordinated.

Extension Activity

1. Suggest the steps required to obtain more precise data about the amount, composition and location of plastic litter in Port Phillip Bay.
2. Suggest a method of data collection that would enable us to determine the origin of plastic litter, in particular nurdles, entering our waterways.