

WATERWATCH

Litter Trackers: reducing littering by education

Primary education resources

Introduction

Our city's rivers and creeks receive stormwater that runs off roofs and roads in urban areas. This stormwater often contains litter carried from Melbourne's streets. Once it enters the drainage system, it is transferred through a series of pipes into local wetlands, creeks and rivers.

Litter items may be trapped in stream-side vegetation, collected by litter traps, or transported along the waterway eventually ending up in Port Phillip Bay. Litter is a direct financial cost to local and state governments, and therefore to the community. It is also harmful to our wildlife in both freshwater and marine environments. The Victorian Government is working to reduce litter to protect our waterways and Port Phillip Bay.

Bottles containing Global Positioning System (GPS) trackers (pictured) have been released in various creeks and rivers by schools and community groups to simulate the movement of litter through the stormwater drainage system. In all, 100 GPS-tracked bottles in 20 locations across Melbourne's catchments have mapped precisely how litter makes its way from our streets to our beaches.

This resource is designed for students in Years 3 to 6. The case study gives an overview of the litter trackers launch and journey. Adapt the activity for your year level.



Litter Tracker bottles. Image courtesy of RMIT University.

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Victorian Curriculum Year 3–6¹ links:

Science

Year 3 and 4 - Science understanding

Science knowledge helps people to understand the effects of their actions (VCSSU056)

Geography

Year 3 and 4 - Geographical knowledge

Types of natural vegetation and the significance of vegetation to the environment, the importance of environments to animals and people, and different views on how they can be protected; the use and management of natural resources and waste, and different views on how to do this sustainably (VCGGK082)

Year 5 and 6 -Geographical concepts and skills

Describe and explain interconnections within places and between places, and the effects of these interconnections (VCGGC087)

Collect and record relevant geographical data and information from the field and secondary sources, using ethical protocols (VCGGC088)

Geographical knowledge

Environmental and human influences on the location and characteristics of places and the management of spaces within them (VCGGK096)

Mathematics

Year 3 - Measurement and Geometry

Create and interpret simple grid maps to show position and pathways (VCMMG143)

Year 4 -Measurement and Geometry

Use simple scales, legends and directions to interpret information contained in basic maps (VCMMG172)

Year 5 –Measurement and Geometry

Choose appropriate units of measurement for length, area, volume, capacity and mass (VCMMG195)

Use a grid reference system to describe locations. Describe routes using landmarks and directional language (VCMMG199)

Year 6 - Measurement and Geometry

Measure, calculate and compare elapsed time (VCMMG227)

Design and Technologies

Year 3 and 4 - Creating Designed Solutions

Generate, develop, and communicate design ideas and decisions using appropriate technical terms and graphical representation techniques (VCDSCD029)

Year 5 and 6 - Creating Designed Solutions

Generate, develop, communicate and document design ideas and processes for audiences using appropriate technical terms and graphical representation techniques (VCDSCD039)

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Activity 1: GPS trackers

Students are introduced to GPS trackers and practise using them around the school grounds.

Activity 2: Measuring time and distance

Students measure the length of time and distance of moving things online and in the school grounds.

Activity 3: Plotting the journey

Students discover the impact of rainfall, vegetation and landscape on the movement of litter in the environment.

Activity 4: Investigation

Students investigate their local waterway and the ways that litter moves through it.

Activity 5: Call to action

Students create an awareness campaign to highlight the importance of putting rubbish in the correct place.

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Case study

Schools and community groups released bottles with GPS litter trackers into 20 rivers and creeks in Melbourne. Each group released five trackers per site, which were monitored for four weeks before being collected.

The table below details one of the releases (in May 2019) including the school and community groups, waterway, location, date and weather. Five litter tracker bottles were released from each site.

School/community group	Waterway and general movement of tracker	Release location	Release date	Weather
Bentleigh West Primary School First Friends of Dandenong Creek	Dandenong Creek Trackers travel short distances and have less stops.	Vermont	28 May 2019	Top temperature: 15.7°C Rain: 0.2 mm Sun: 0.2 hours Wind: 9am N 19 km/hr 3pm N 9 km/hr
Antonine College Merri Creek Management Committee Waterwatch	Merri Creek Trackers travel long distances quickly. Can go back and forth (back up the Yarra River).	Brunswick East	31 May 2019	Top temperature: 14.3°C Rain: 1.4 mm Sun: 1.1 hours Wind: 9 am SW 9 km/hr 3 pm SSW 9 km/hr
Our Lady of the Nativity Primary School	Maribyrnong River Trackers travel long distances quickly. Can go back and forth (back up the Maribyrnong River).	Aberfeldie	31 May 2019	Top temperature: 14.3°C Rain: 1.4 mm Sun: 1.1 hours Wind: 9 am SW 9 km/hr 3 pm SSW 9 km/hr

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Over the next four weeks, the litter tracker bottles travelled along the waterway. Some found their way out into Port Phillip Bay.

Figure 1 shows the journey of one bottle from the Dandenong Creek release. Each dot shows where the litter tracker bottle stopped and how far it moved within four weeks. More maps from the first launch can be found in the appendices.

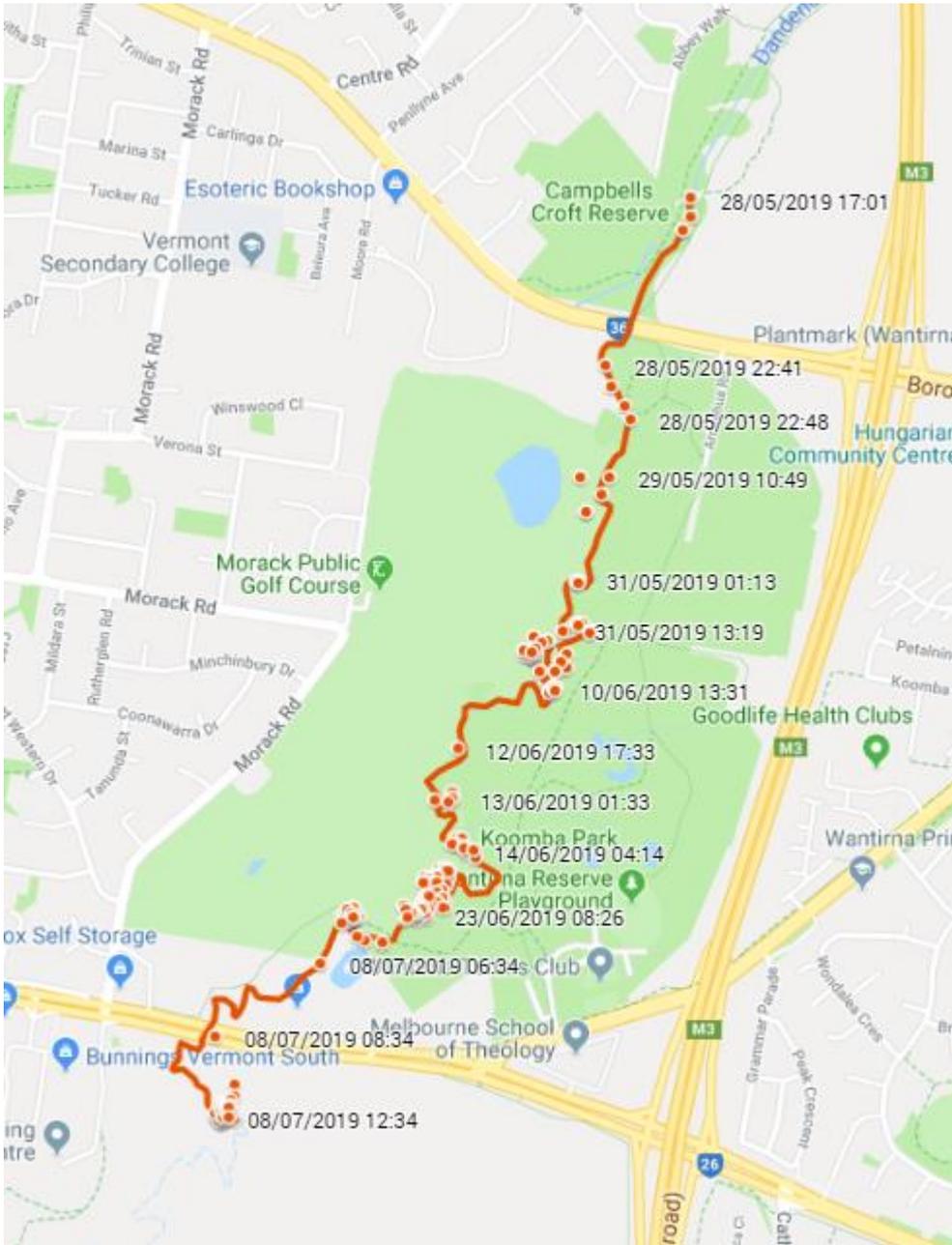


Figure 1. Dandenong Creek Bottle 1, released 28 May 2019.

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Rainfall impacts the river level and flow of each waterway. Figure 2 shows the rainfall during the month of June at each launch site. It also includes the monthly average for June at that site.

Location	Monthly rainfall (mm) June 2019	Average rainfall (mm) June
Dandenong Creek, Vermont	51.6	66.8
Merri Creek, Brunswick East	51.6	56.0
Maribyrnong River, Aberfeldie	52.2	40.7

Figure 2. Rainfall at launch sites June 2019. Source: [Rainfall and river levels](#), Melbourne Water

While the trackers are in the waterways, you can follow them on the [Litter Trackers map](#). Each time a tracker completes a trip, the red dot appears on the map as a trajectory. A 'trip' is when the tracker moves and then stops. The green dot shows its most recent location. Data is updated every 24 hours at 1 am. The map does not show live data. The map allows you to select 'street map' (see Figure 3) or 'satellite image' (see Figure 4) view.

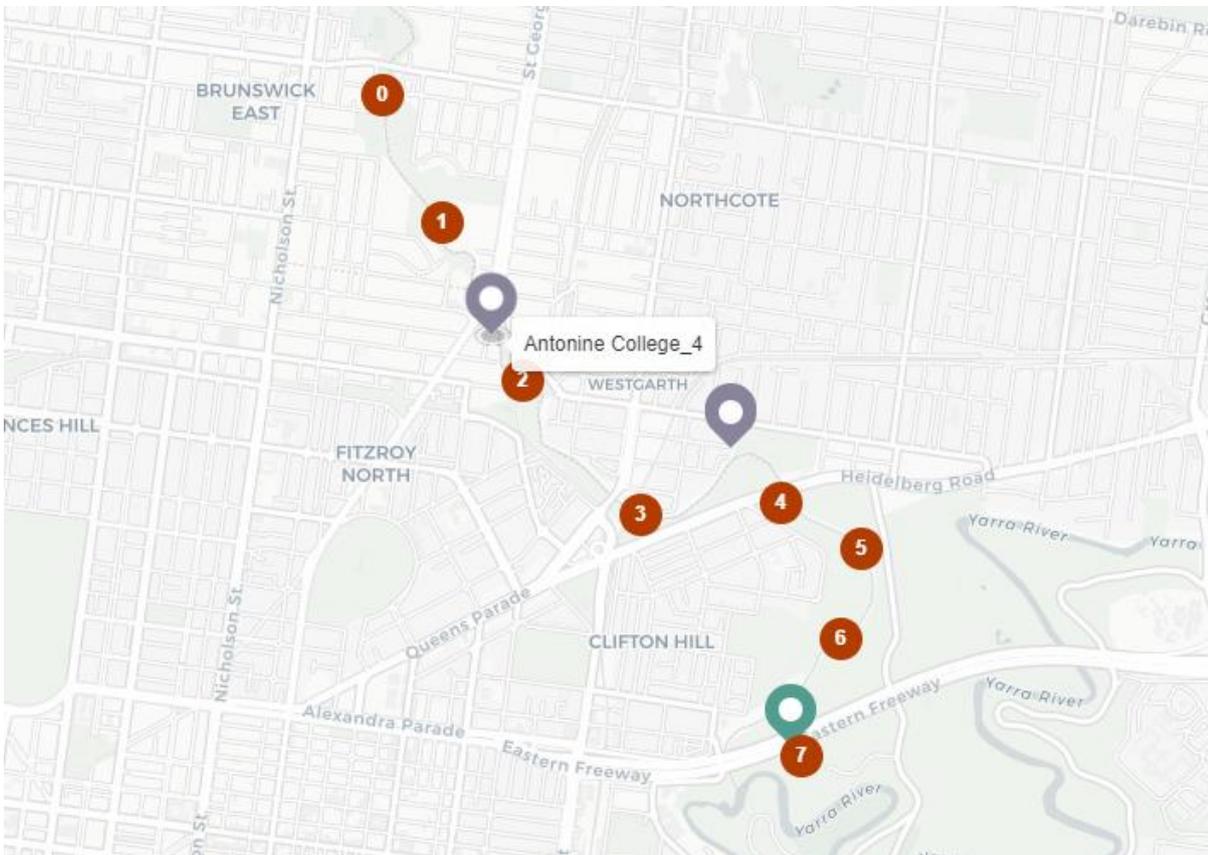


Figure 3. Street map view of the journey of the Merri Creek Bottle 4, released 31 May 2019.

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Figure 4 shows the satellite map of a release at Gardiners Creek (released on 25 July 2019). As you hover over each red dot, you can see the time and date the tracker was at each position (Figure 5).

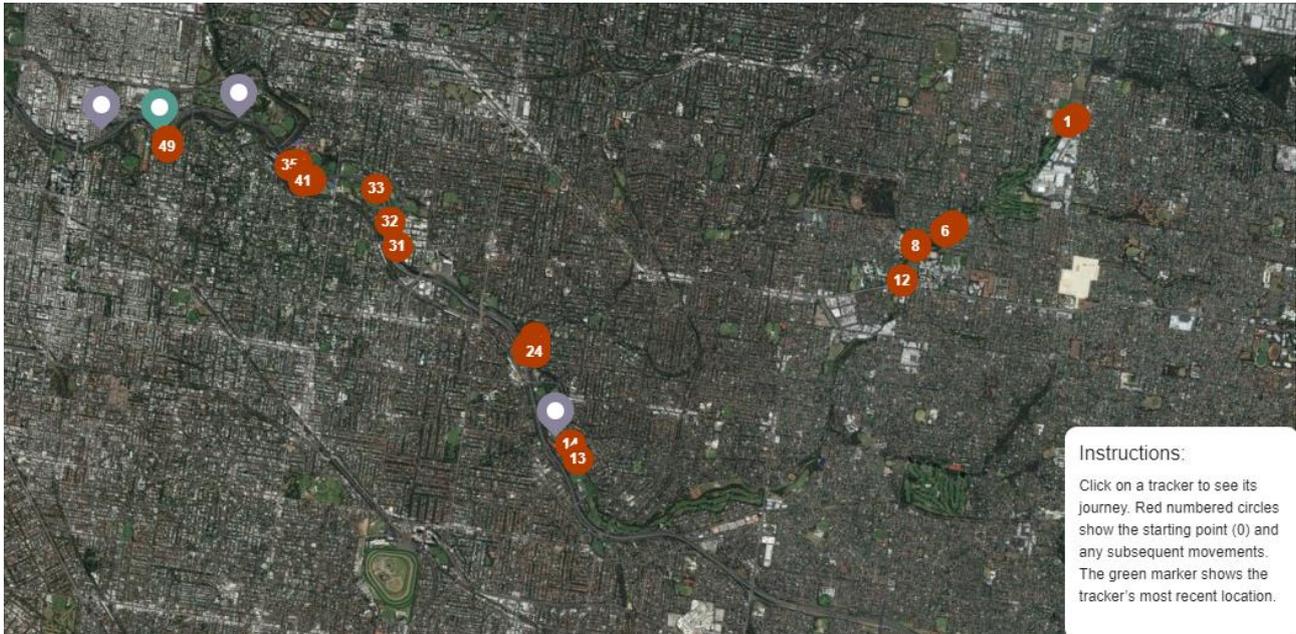


Figure 4. Satellite image of Gardiners Creek Bottle 4, released 25 July 2019.

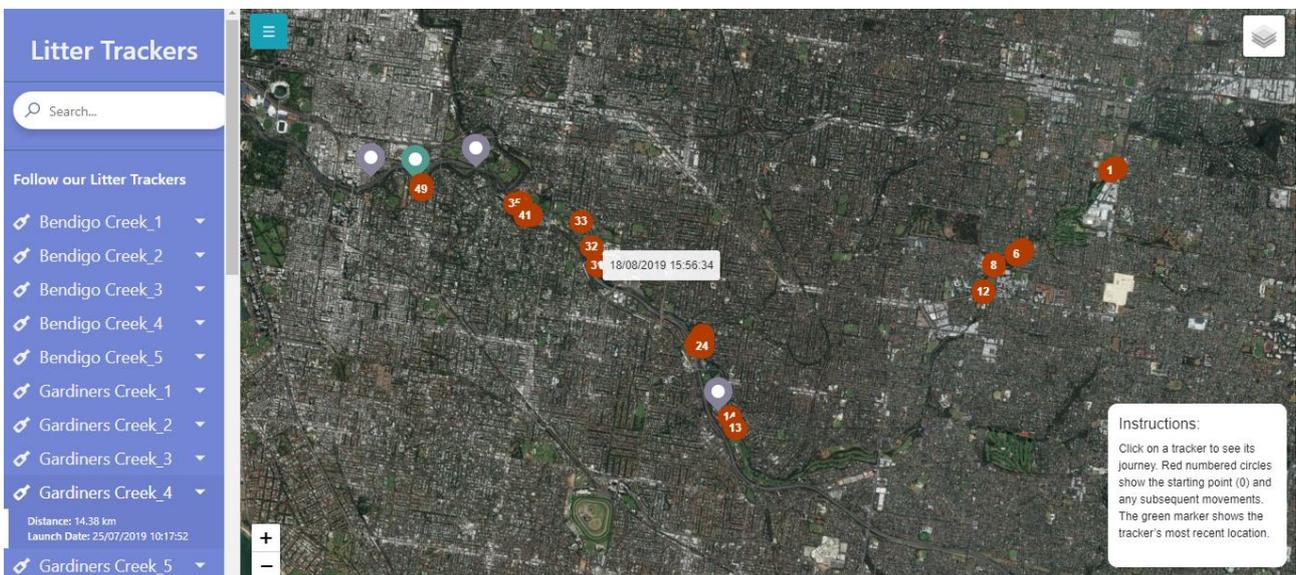


Figure 5. Date and time of each stop.

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According to the [Keep Australia Beautiful National Litter Index](#) (2017/2018), the top ten most littered items nationally are:

1. Cigarette butts (and their packaging)
2. Plastic snack bags and confectionary wrappers
3. Plastic straws
4. Plastic bottle tops
5. Metal bottle tops and can ring pulls
6. Carbonated soft drink and flavoured water in cans
7. Paperboard cups and paperboard takeaway food containers
8. Plastic takeaway containers and plastic cups
9. Paper shopping docketts and shopping lists
10. Paperboard coffee cups.

This rubbish enters our waterways every day, taking a similar journey to the litter tracker bottles.

The following activities incorporate information from the case study, data from the litter trackers map and real-life learning to assist students in understanding the litter trackers project and the problem of litter in our waterways.

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Activity 1: GPS trackers

Students learn how GPS works and practise using it with a tablet device.

Equipment

For the teacher:

Whiteboard and markers

Smartboard or TV connected to the internet

[How does GPS work?](#) video [1:42] This video provides an overview of Global Positioning Systems.

[Stormwater runoff pollutes](#) animation [0:30] This animation uses text to explain where stormwater comes from.

[Stormwater pollution the dirty truth: home activities](#) animation [1:48] An animation that explains the products that shouldn't go into stormwater.

[Where does stormwater go?](#) animation [2:13] Find out how quickly stormwater enters our waterways in urban areas.

[Stormwater runoff model](#) video [1:45] This video uses a stormwater runoff model (in a plastic tub) to demonstrate what is washed into our waterways when it rains.

For the student:

A tablet for each student or each group

Preparation

Download the Google Maps app onto each tablet. Ensure location services is turned on for that app.

Activity steps

1. As a class, discuss Global Positioning Systems (GPS). What do students already know about GPS? Why is it useful?
 - We use it for finding an address, calculating distance and time, exploring what is close by or when we're walking or hiking. We can also use it for environmental purposes.
2. Ask students if they can think of anything that might use GPS. For example:
 - trucks, shipments, surveying
 - animals (see the Arthur Rylah Institute project [Tracking eel migration using satellites](#)).
3. Watch the video [How does GPS work?](#) [1:42]
4. On the whiteboard, draw a simple map of the classroom. Ask a student to walk around the classroom. While they do this, another student plots their movements on the whiteboard with a marker. Explain that this is what GPS does.
5. Draw a simple map of the school on the whiteboard. Include grid lines and direction.

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6. Introduce students to Google Maps (on a tablet). Explain that the blue dot is the device and it will move when the device moves (location services must be turned on for that app).
7. Students move outside with their tablet to watch the blue dot move as they move around the school.
8. Back in the classroom, discuss the accuracy of the map. (Google Maps knows your location up to around 20 metres.)
9. Ask students to plot their movements on the whiteboard map. They could also draw their own map on paper and mark their movements on it.
10. Introduce the Litter Trackers project. This project tracks litter and the movement of rubbish in our waterways.
11. Watch one of the following videos about stormwater runoff pollution:
 - [Stormwater runoff pollutes](#) animation [0:30]
 - [Stormwater pollution the dirty truth: home activities](#) animation [1:48]
 - [Where does stormwater go?](#) animation [2:13]
 - [Stormwater runoff model](#) video [1:45]
12. Discuss some things students may have seen on the ground that could eventually end up in our waterways. What can we do to prevent that?

Years 5 and 6 extension

- a) Students draw their own map of the classroom, including tables, chairs, shelving, storage rooms, entry and exit etc.
- b) In groups of four, two students walk around the classroom while two other students plot their journey on their own map. Then swap tasks.
- c) Students draw their own map of the school (or their area of the school if it's a large school) using grid lines and directions.
- d) Brainstorm where the litter might start then end (e.g. starting as rubbish in the school yard, blowing into the gutter, washing into stormwater drains, out to creeks and rivers and eventually out to Port Phillip Bay and into the open ocean to become marine debris). Discuss the problems litter can cause in waterways and the ocean.

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Activity 2: Measuring time and distance

Students learn how to measure distance and observe time on a digital and paper map.

Equipment

For the teacher:

Whiteboard and markers

Smartboard or TV connected to the internet

[The Litter Trackers](#) website

For each group:

A basketball or large round ball

For the student:

A tablet for each student or each group

Preparation

Download the Google Maps app onto each tablet. Ensure location services is turned on for that app.

Activity steps

1. Display the [Litter Trackers](#) website on the smartboard.
2. Click on the box 'Follow the trackers' underneath the map. Explain that GPS allows us to follow the trackers' journey. Each time a tracker completes a trip, the red dot appears on the map as a trajectory. A trip is when the tracker moves and then stops. The green dot shows its most recent location. Data is updated every 24 hours at 1 am. The map does not show live data. The tracker started at 0, the red numbers show where the tracker has travelled and the last number is where it has stopped.
3. Compare the journey on the map to a local route. For example, display a map of the local area on the smartboard or TV. Show students the route from school to a local sporting oval or pool, or to the closest supermarket. With markers, draw the route over the top of the map on the whiteboard.
4. Students draw a map of the school (or their year level area of the school) including grid lines and direction. It should also include the map's scale (metres are best for this activity). Figure 6 shows a map of a sample school, including grid lines, scale and direction.

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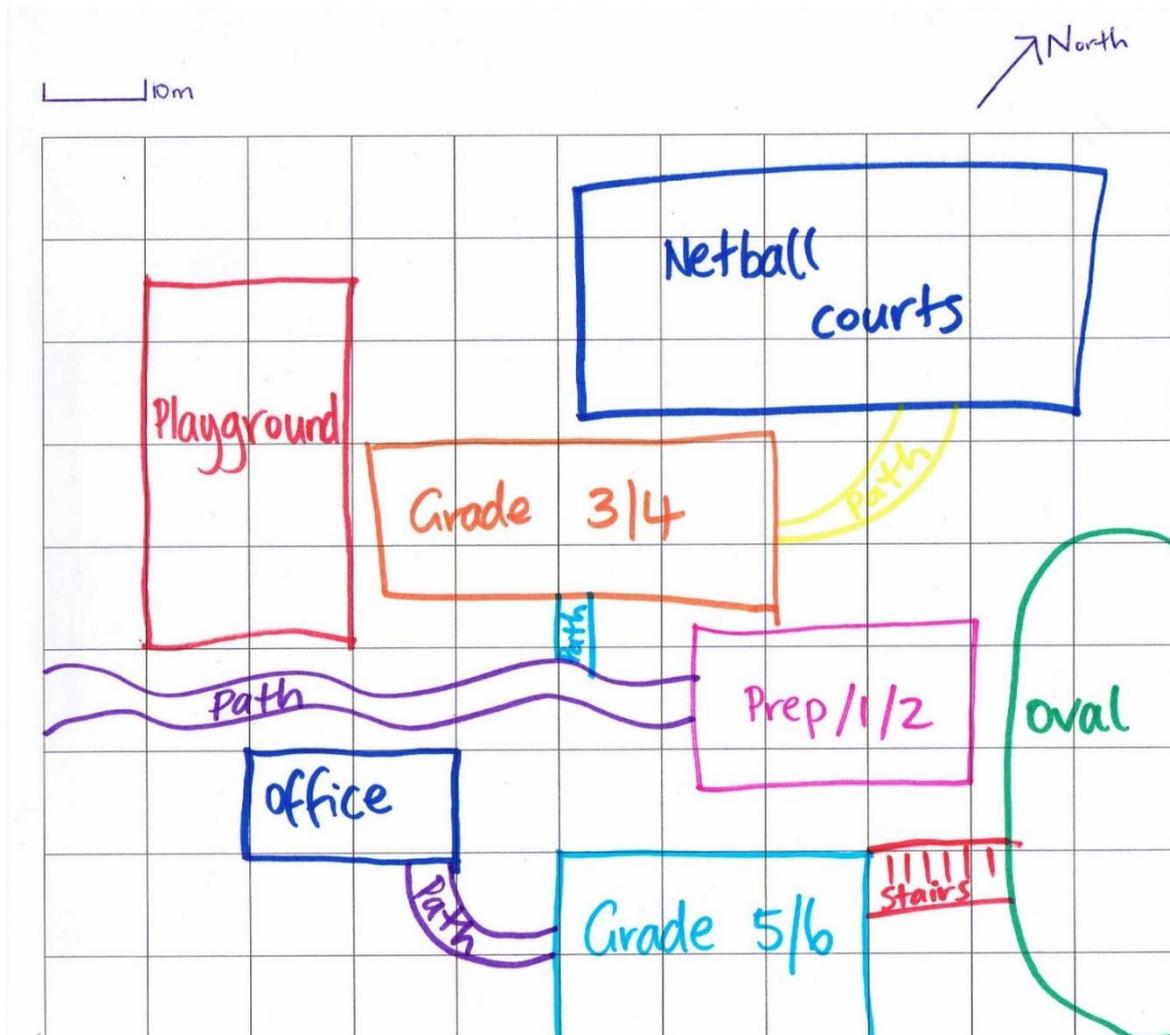


Figure 6. Map of a sample school.

- In groups, students take a ball and their map outside. Find a place clear of obstacles and ask students (in groups) to throw the ball. Students record the answers to the following questions:
 - Where does the ball stop?
 - Which path does it go down?
 - What does it hit along the way?

One student can plot the ball's path roughly on their map while outside.

- Back in the classroom, students plot the ball's journey on their map and share their findings. What was common? (e.g. did the ball get stuck or stop in the same place? Did it travel down the same path? Did a gust of wind blow it off course? Was there a stick in the way that made it move in a different direction?) Explain that these things might happen to the litter tracker bottles while they're in the water.

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7. Revisit the litter trackers map and discuss things that may have made the bottles stop and start up again.

Years 5 and 6 extension

- a) Measure the distance the ball travelled by using the grid lines and the map's scale.
- b) As a class, look at the maps in the appendices:
 - Appendix 1. Dandenong Creek bottles
- c) Where did the litter trackers start? Where did they stop? Where are the clusters of stop-starts (i.e. the clusters of dots)?
- d) Using [Google Maps](#) (app on a tablet or on the website), measure the distance the journey has taken. Refer to the following appendices for instructions on how to measure in Google Maps:
 - Appendix 2. How to measure distance on Google Maps (app)
 - Appendix 3. How to measure distance on Google Maps (internet)
- e) Look at the starting point date and time of the trackers and the end point date and time. How long has it taken each litter tracker bottle to travel the distance it has travelled? Is that slow or fast, in your opinion?
- f) Discuss the differences in the waterways that might make the litter trackers speed up, slow down or go backwards. For example, is there vegetation stopping the bottles or is the waterway paved?
- g) Display the [Litter Trackers](#) map on the smartboard or TV.
- h) Investigate the distance and time it has taken other litter tracker bottles to move.



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Activity 3: Plotting the journey

Students determine the factors that affect the movement (or lack of movement) of the litter tracker bottles.

Equipment

For the teacher:

Smartboard or TV connected to the internet

Google Maps app

Google Earth app

[The Litter Trackers](#) website

[Bureau of Meteorology climate data](#) website

For the student:

A tablet for each student or each group

Preparation

Download the Google Maps app onto each tablet. Ensure location services is turned on for that app.

Download the Google Earth app onto each tablet.

Activity steps

1. Revisit the 'litter trackers' maps in the appendices.
2. Using the rainfall charts in the case study and the maps, students complete the following:
 - Look at the overall rainfall for June 2019 compared with the average for June. Is it more or less?
 - What effect would rainfall have on the movement of the litter tracker bottles?
3. Using Google Maps or Google Earth, turn on satellite view then type in the address of a launch site. Zoom in on the waterways. Trace the route of the litter tracker bottles along the waterway.
 - Is the waterway surrounded by trees or grass?
 - Are there houses and factories nearby?
 - Can you see any boat ramps, boats or ships?
 - Do the waterways travel through built up areas or bushland?
 - Can you see any wetlands?
 - Can you see any diversions?
 - Can you see what the base of the waterway is (e.g. concrete, mud, paving etc.)?

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4. Discuss what this might mean for the litter tracker bottles.

For example, the trackers may:

- get stuck in reeds or rocks
- bump into boats
- be dragged along by a ship
- be stuck in a wetland
- be stuck with other rubbish
- bump into a bridge.

Years 5 and 6 extension

Figure 7 shows the location of litter traps in Melbourne's waterways. Litter traps are large structures anchored in the river that collect floating rubbish. Have any litter trackers been caught by a litter trap?

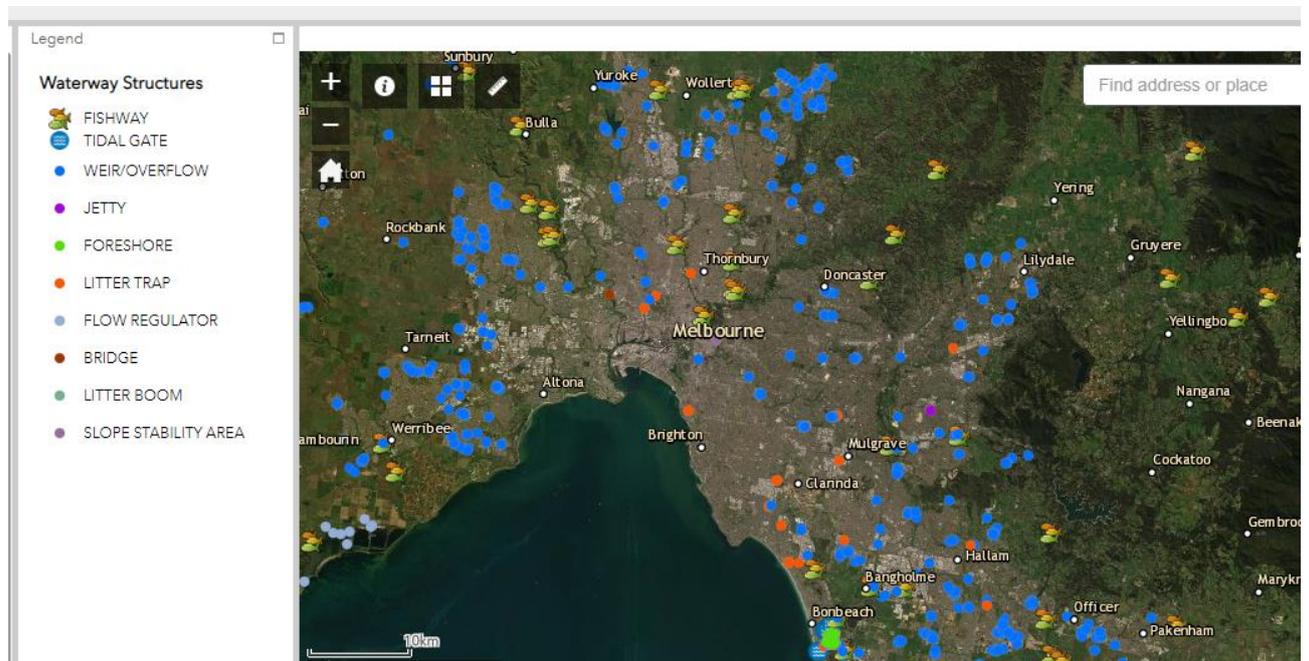


Figure 7. Location of litter traps along Melbourne's waterways.



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Activity 4: Investigation

Students devise solutions to litter problems in their local area.

Equipment

For the teacher:

Smartboard or TV connected to the internet

[The Litter Trackers](#) website

Clean Up Australia website

Paper map of local area

For the student:

A tablet for each student or each group

Paper map of local area

Preparation

Download the Google Earth app onto each tablet.

Activity steps

1. Discuss how litter can travel from the ground, into stormwater drains, into the waterways and eventually end up in the bay.
2. Using a paper map of your local area, students find the closest waterway (river, creek etc.) to school or to where they live. Trace a pencil along the waterway, following its twists and turns until it reaches Port Phillip Bay. Discuss:
 - How far would it have to travel?
 - What locations would it pass through?
 - Is there anything that might stop the litter?
3. Look at the same waterway on Google Earth. Can you add to your answers?
4. As a class, using the top ten most littered items in the case study (p. 8), list one environmental impact for each litter item. For example: cigarette butts can take up to five years to break down but they don't degrade. They also add harmful chemicals into a waterway. Plastic bags can choke animals that ingest them.



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Years 5 and 6 extension

Investigate the impacts of litter on the environment. Students choose one item from the list of the top ten most littered items in the case study (p. 8) and investigate how it might travel from someone's hand or pocket to our waterways and beaches. Include details such as:

- where it has come from (e.g. thrown from a car, dropped on the street, blown from an overflowing bin)
- what factors contributed to it getting to the waterway (e.g. heavy rain, strong wind)
- what happens once it's in the waterway (e.g. harms aquatic life, is trapped in the creek for years).

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Activity 5: Call to action

Students design an awareness campaign to help combat the litter problem.

Equipment

For the teacher:

Smartboard or TV connected to the internet

[The Litter Trackers](#) website

For the student:

Access to a tablet or video and video editing software (see Useful resources for suggestions)

Preparation

Download video editing software onto each tablet.

Activity steps

1. Students create a slogan and awareness campaign to help others in your school and community to think about litter and where it ends up. Detail the problems and the solutions. They could:
 - create a poster or digital presentation
 - act out a skit, video or radio ad
 - produce an animation.
2. Promote students' ideas and products in the school newsletter, the school website or on your school Facebook page or blog (if you have one). Follow the Litter Trackers Facebook page for current launches and information.

Years 5 and 6 extension

- a) Design and write a pledge to use less plastic, put rubbish in the bin or organise a clean-up day.
- b) Run a neighbourhood or school litter audit
- c) Consider participating in one of the following campaigns with your class or school:
 - [Clean Up Australia Day](#)
 - [Nude Food Day](#)
 - [Plastic Free July](#)



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Useful resources

[AQUEST \(Aquatic Environmental Stress Research Group\)](#)

The Aquatic Environmental Stress research group assesses the health of aquatic ecosystems, inland waterways and estuaries, using a weight-of-evidence approach based on environmental outcomes. The AQUEST team are involved in the Litter Trackers project.

[Australian Marine Debris Initiative \(Tangaroa Blue\)](#)

Tangaroa Blue Foundation is an Australia-wide not-for-profit organisation dedicated to the removal and prevention of marine debris: one of the major environmental issues worldwide.

[Bureau of Meteorology](#)

The Bureau of Meteorology is Australia's national weather, climate and water agency.

[Google Maps](#)

Google Maps is a web mapping service developed by Google. It offers satellite imagery, aerial photography, street maps, 360° panoramic views of streets, real-time traffic conditions, and route planning for traveling by foot, car, bicycle and air or public transportation.

[Google Earth](#)

Google Earth is a computer program that renders a 3D representation of Earth based primarily on satellite imagery. The program maps the Earth by superimposing satellite images, aerial photography, and GIS data onto a 3D globe, allowing users to see cities and landscapes from various angles.

[Keep Australia Beautiful National Litter Index \(2017/2018\)](#)

The Keep Australia Beautiful National Litter Index (NLI) is Australia's only national, annual, quantitative measure of what litter occurs where and in what volume. Litter counts are done twice annually across 983 sites nationally to create an annual report on litter in each State and Territory that can be compared to the national average.

[The Litter Trackers: reducing littering by education](#)

The Litter Trackers is a collaborative project between RMIT University and Melbourne Water, supported by the Victorian Government. As part of the Litter Trackers project, scientists will work with schools and community groups to launch GPS tracked bottles into Melbourne's waterways to demonstrate how and where litter travels once it enters our waterways.

[Melbourne Water](#)

Melbourne Water is a statutory authority owned by the Victorian Government. It is their role to manage and protect Melbourne's major water resources on behalf of the community. Melbourne Water is involved in the Litter Trackers project.



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National Map

National Map is an online map-based tool to allow easy access to spatial data from Australian government agencies. It was an initiative of the Department of Communications and the Arts (DCA) now currently managed by the Digital Transformation Agency (DTA) and the software has been developed by Data61 working closely with the DCA, Geoscience Australia and other government agencies.

The Pesticide Detectives

The Pesticide Detectives is an extensive national Citizen Science project investigating the occurrence and concentrations of pesticides used in homes and gardens as well as agricultural and urban settings in Australia's waterways.

Funded by the Department of Industry, Innovation and Business, Pesticide Detectives is a collaborative project combining the scientific expertise of RMIT University's Aquatic Environmental Stress Research Group (AQUEST) scientists and Citizen Science volunteers in the collection of sediment samples from waterways across Australia.

Scribble Maps

With Scribble Maps you can create and share custom maps, embed maps on websites, and create images or PDF.

Video editing software

- [Blender](#)
- [Lightworks](#)
- [Shotcut](#)
- [Openshot](#)
- [Splice app](#)



WATERWATCH Litter Trackers: reducing littering by education

Media links

You can follow the Litter Trackers project on Facebook: [@littertrackers](#)

The project has received widespread media coverage.

Please refer to the links below:

[From the burbs to the bay: GPS tracking reveals how litter travels](#)

[A rubbish idea: GPS-tracked bottles show how litter moves through Melbourne's waterways](#)

[Litter tracking project launches in Healesville](#)

[It's legit, miss: The kids who litter to save the environment](#)

[Oyster2 used as 'simulated litter' in RMIT campaign](#)

[Tracking litter on Merri Creek](#)

[Williamstown students use the GPS bottles to track litter](#)

[Williamstown High School—Marine biology](#)



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Learn more about what is being done to stop litter

[Australian Marine Debris Initiative](#)

Tangaroa Blue Foundation is an Australia-wide not-for-profit organisation dedicated to the removal and prevention of marine debris: one of the major environmental issues worldwide

[Beach Patrol](#)

Beach Patrol is an organised network of volunteers and community beach cleaning groups who clean the beaches of Melbourne to make them safer and more enjoyable for everyone.

[Clean Up Australia Day](#)

Clean Up Australia inspires and empowers communities to clean up, fix up and conserve our environment. The website has information on clean-up events and resources about the impact of litter.

[Environment Education Victoria](#)

Environment Education Victoria (EEV) is a professional association of educators for sustainability. EEV offers membership for teachers and free classroom resources.

[Keep Australia Beautiful](#)

Keep Australia Beautiful is a national organisation that is recognised as Australia's independent litter prevention thought and practice leader, for a litter free and sustainable Australia.

[National Litter Index](#)

A national measure of the presence of litter across the country.

[Responsible Runners](#)

An organisation that asks the community to join them across Australia for a fun 30 minute clean-up to meet like-minded people and protect our marine environment. They also help sort recyclables and collect data for the Australian Marine Debris Initiative.

[Victorian Litter Action Alliance, Sustainability Victoria](#)

Sustainability Victoria supports state and local government, land managers and other partners to address litter and illegal dumping issues.

[Waterwatch Victoria](#)

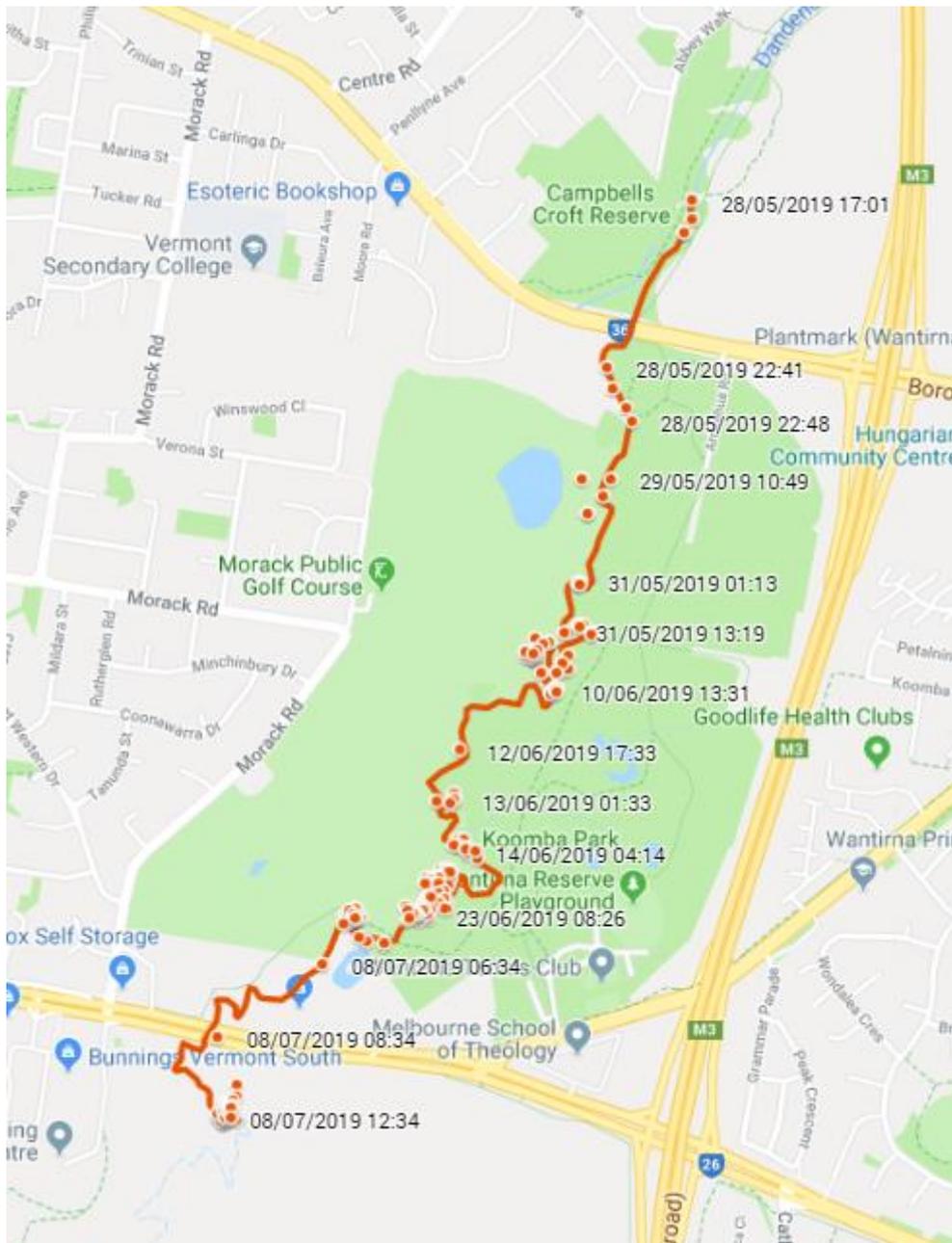
Waterwatch is a citizen science community engagement program connecting local communities with river health and sustainable water issues and management.

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Appendix 1

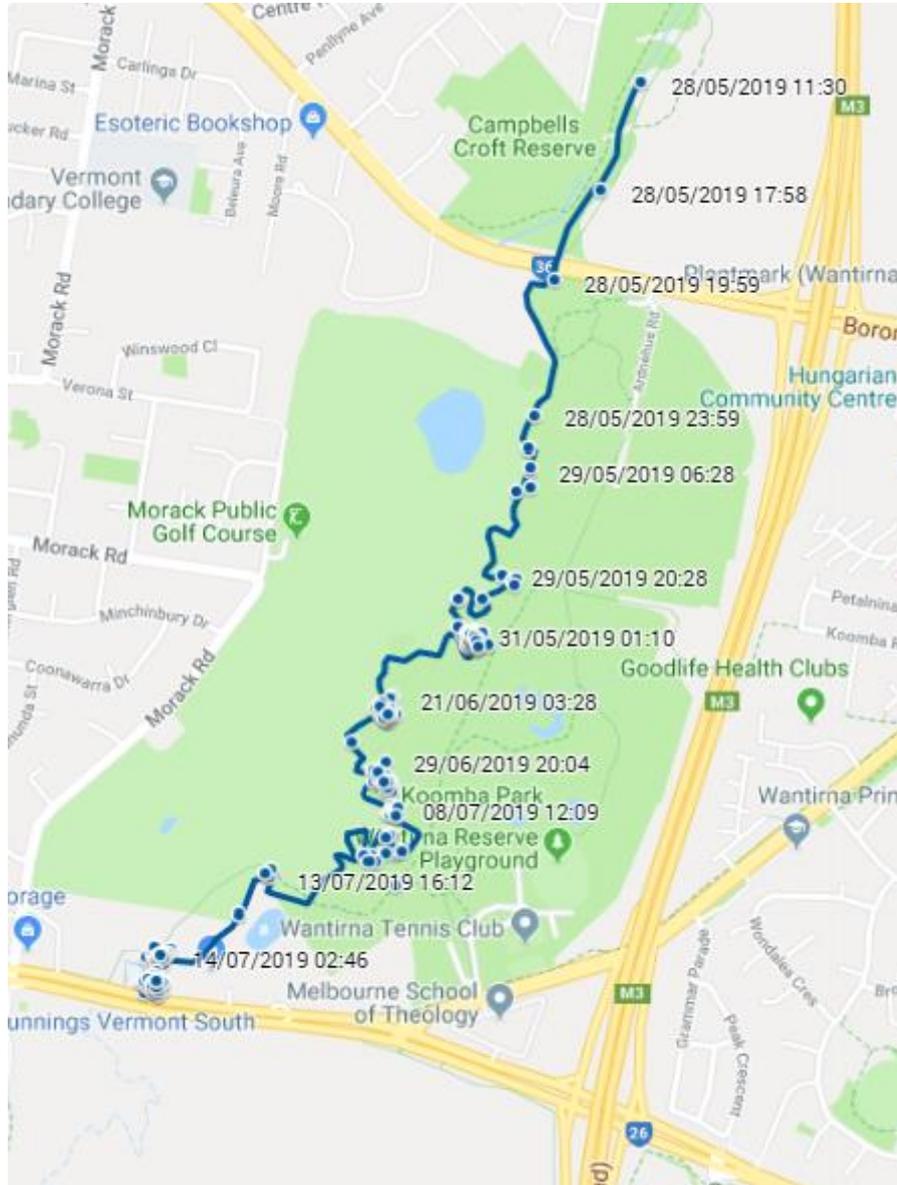
Dandenong Creek maps

Dandenong Creek Bottle 1 journey with dates.



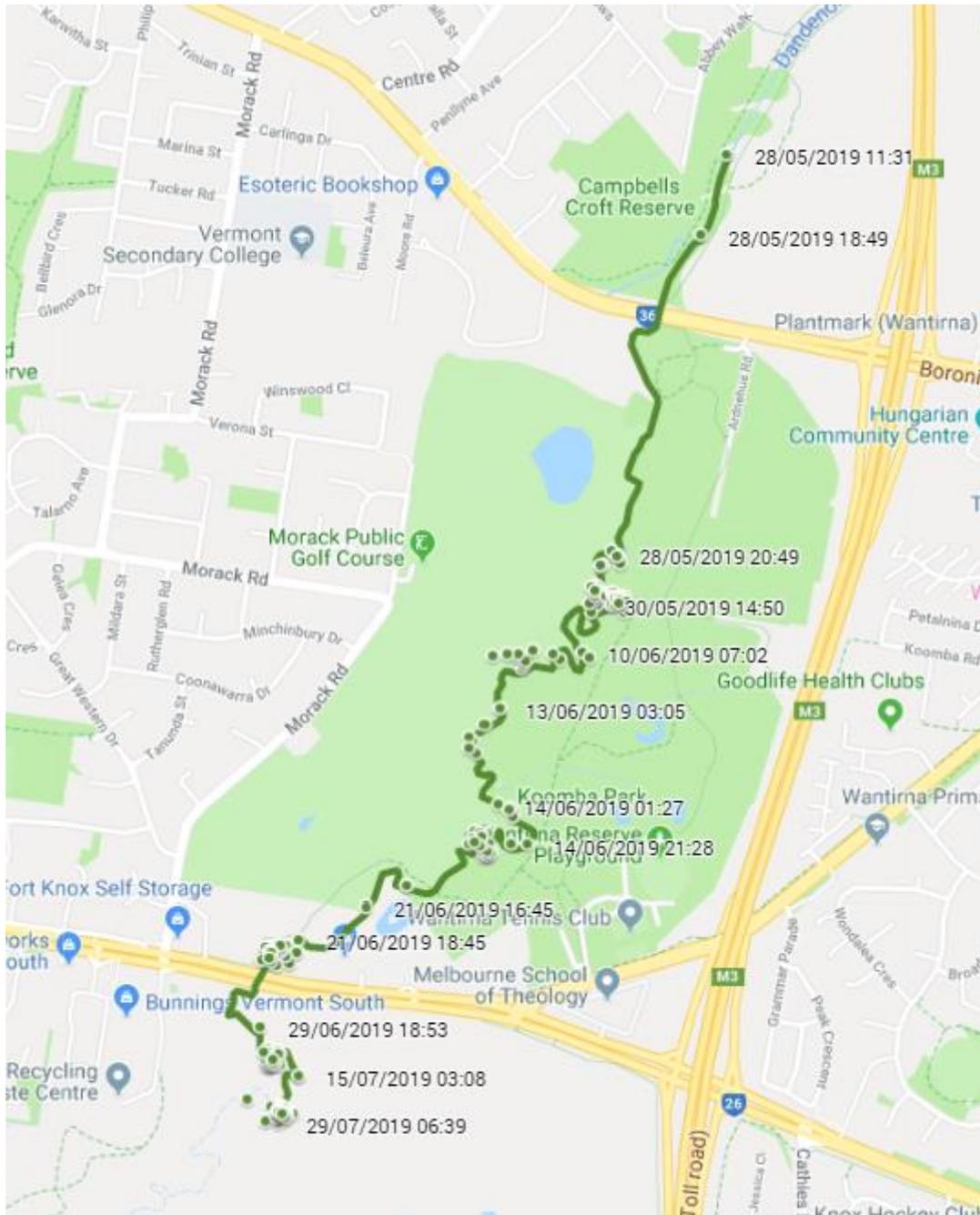
WATERWATCH Litter Trackers: reducing littering by education

Dandenong Creek Bottle 2 journey with dates.



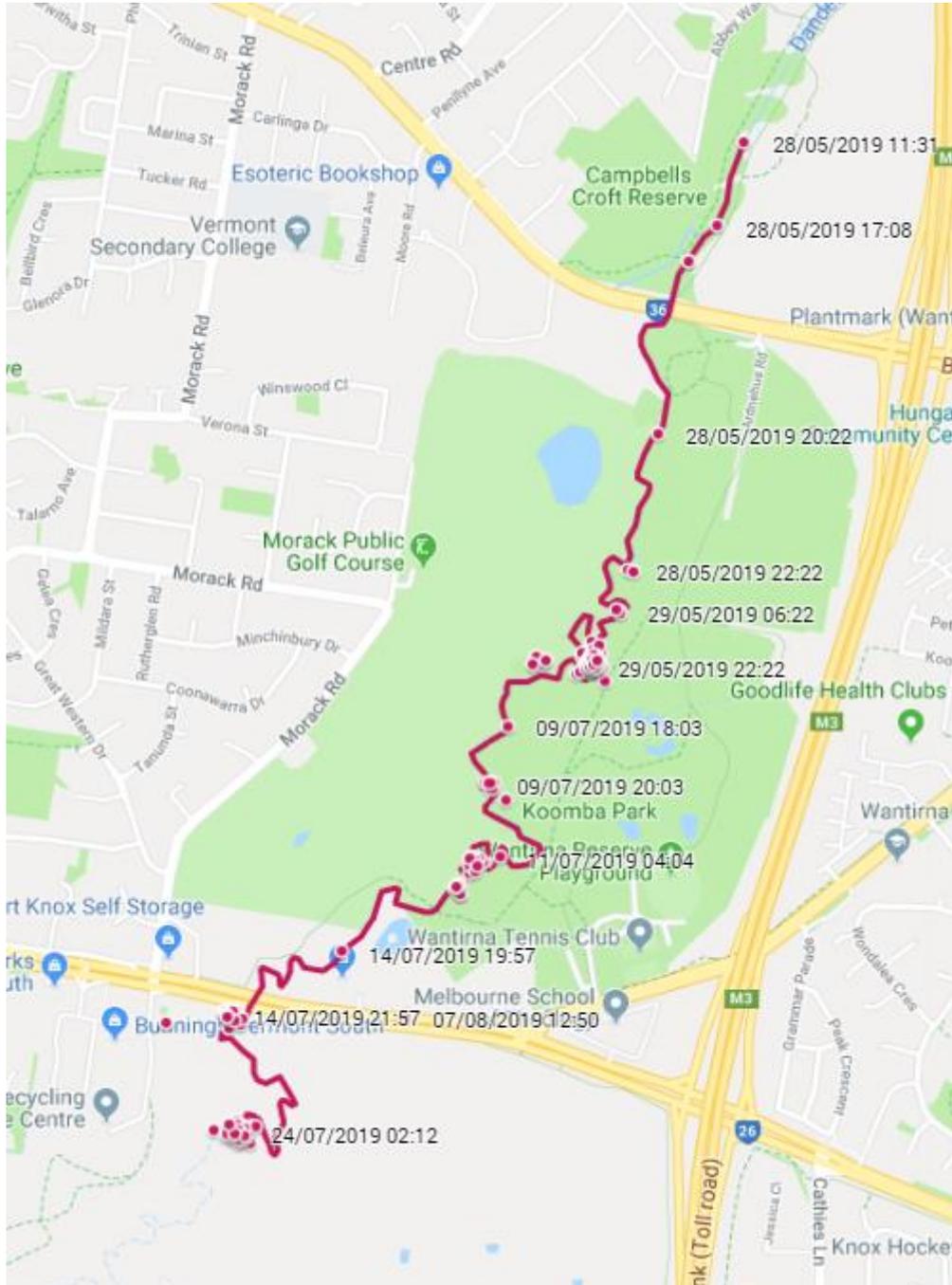
WATERWATCH Litter Trackers: reducing littering by education

Dandenong Creek Bottle 3 journey with dates.



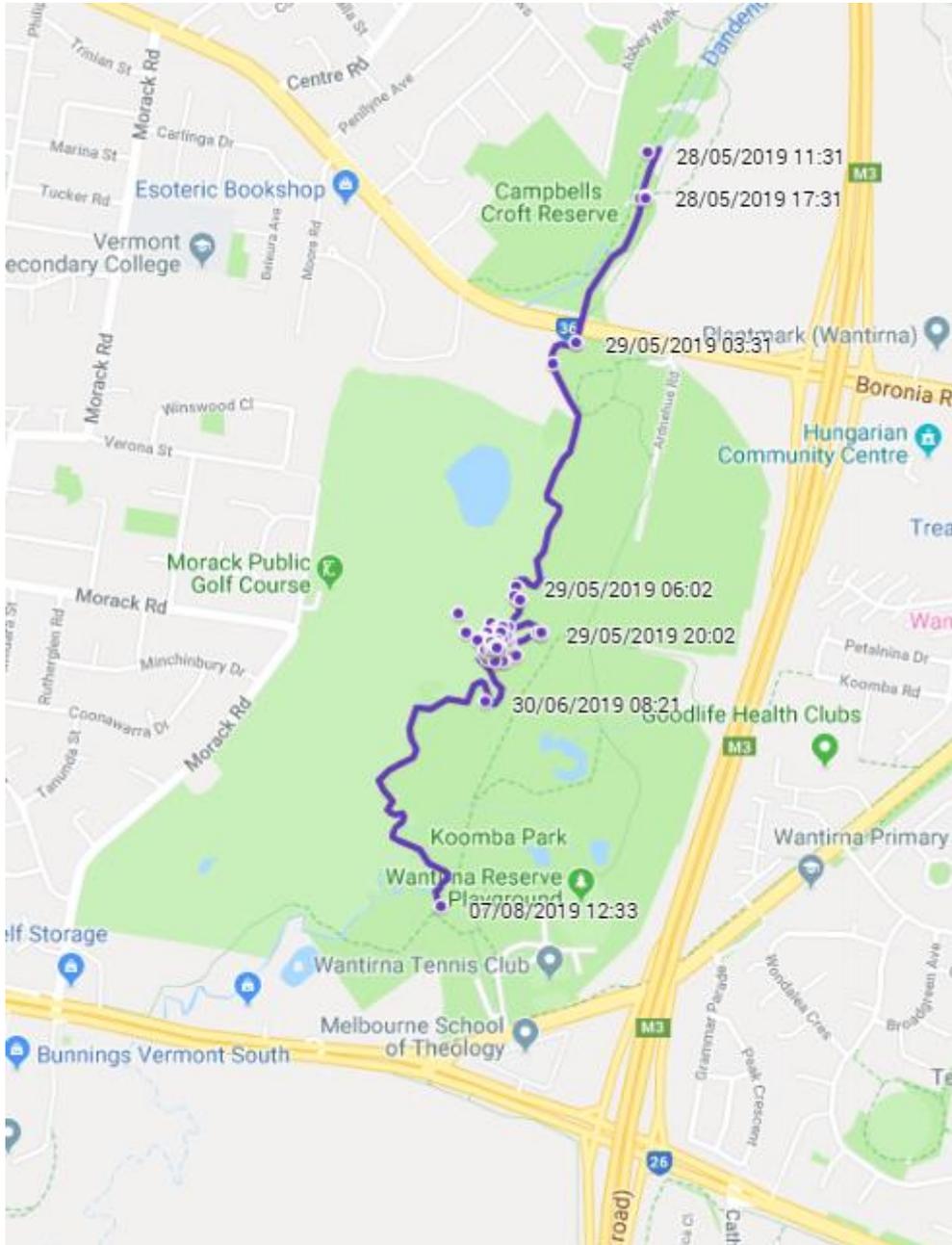
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Dandenong Creek Bottle 4 journey with dates.



WATERWATCH Litter Trackers: reducing littering by education

Dandenong Creek Bottle 5 journey with dates.



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Appendix 2

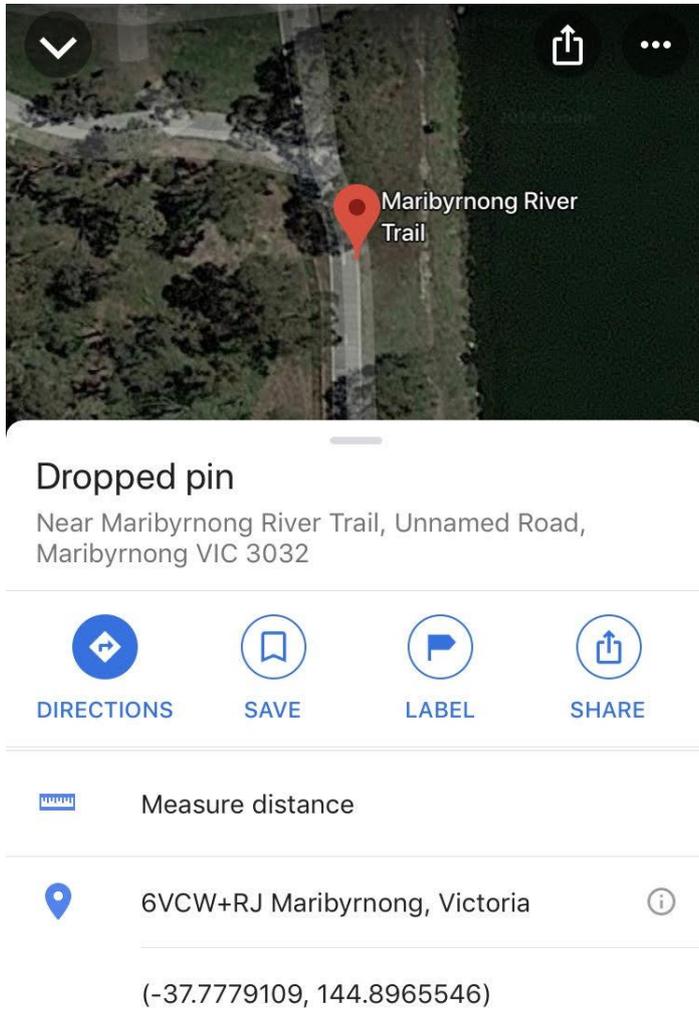
How to measure distance on Google Maps (app)

Type into the search bar the name of the site (e.g. Maribyrnong River Trail).



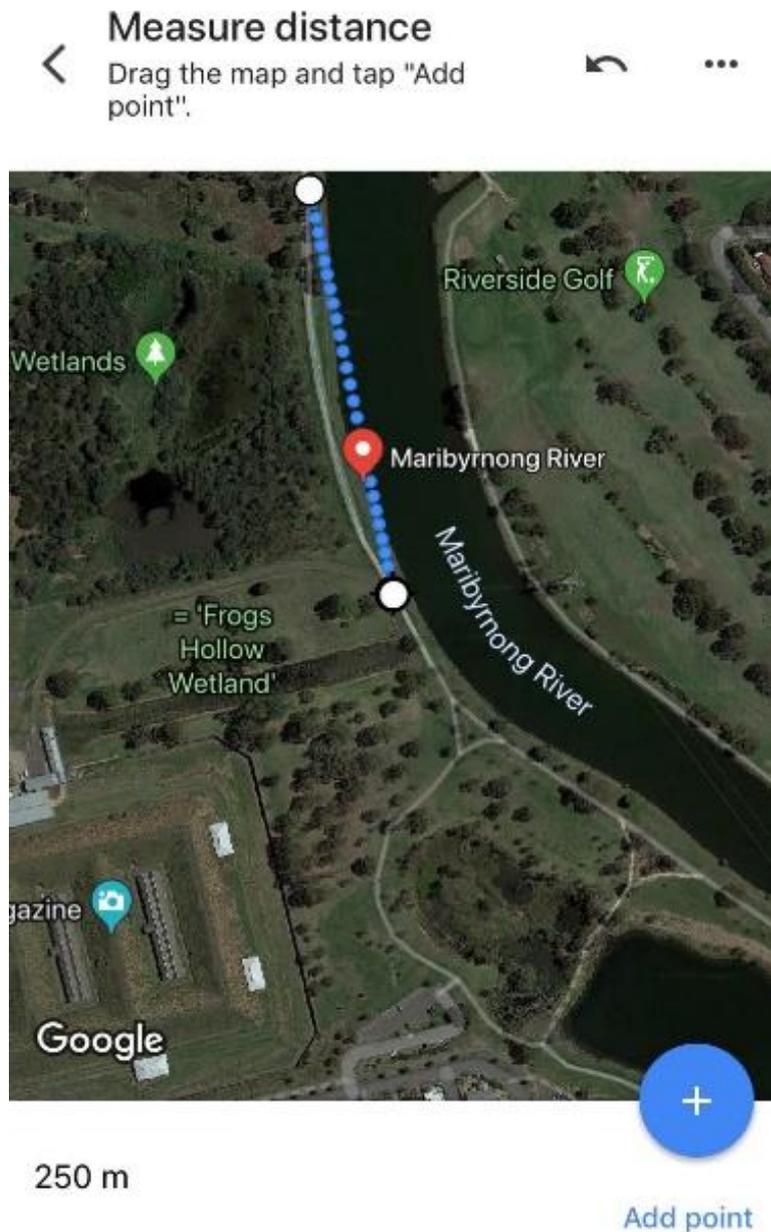
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Select exact location and hold screen. Dropped pin will appear along with a red place marker. Tap the ruler 'Measure distance'.



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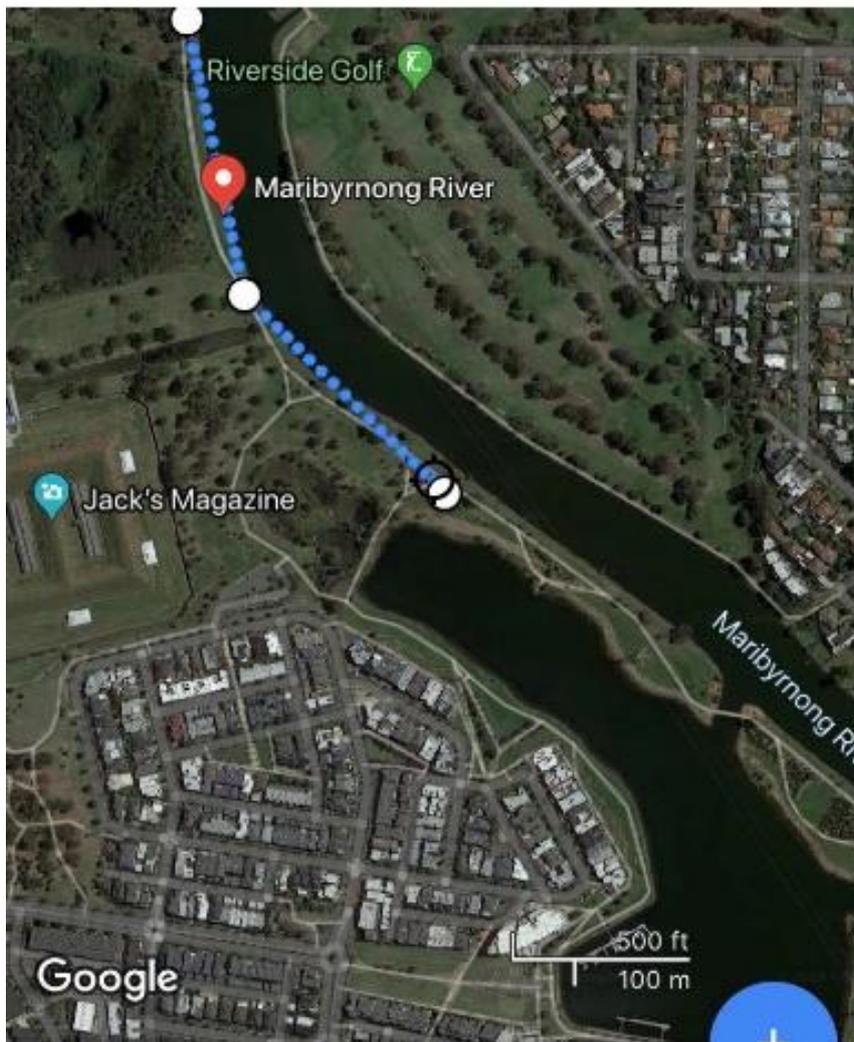
As per the instructions on the screen, drag the map and tap 'Add point' (plus sign inside the blue circle). The distance shows beneath.



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Continue adding points until you have reached the end point.

Measure distance
Drag the map and tap "Add point".



500 m

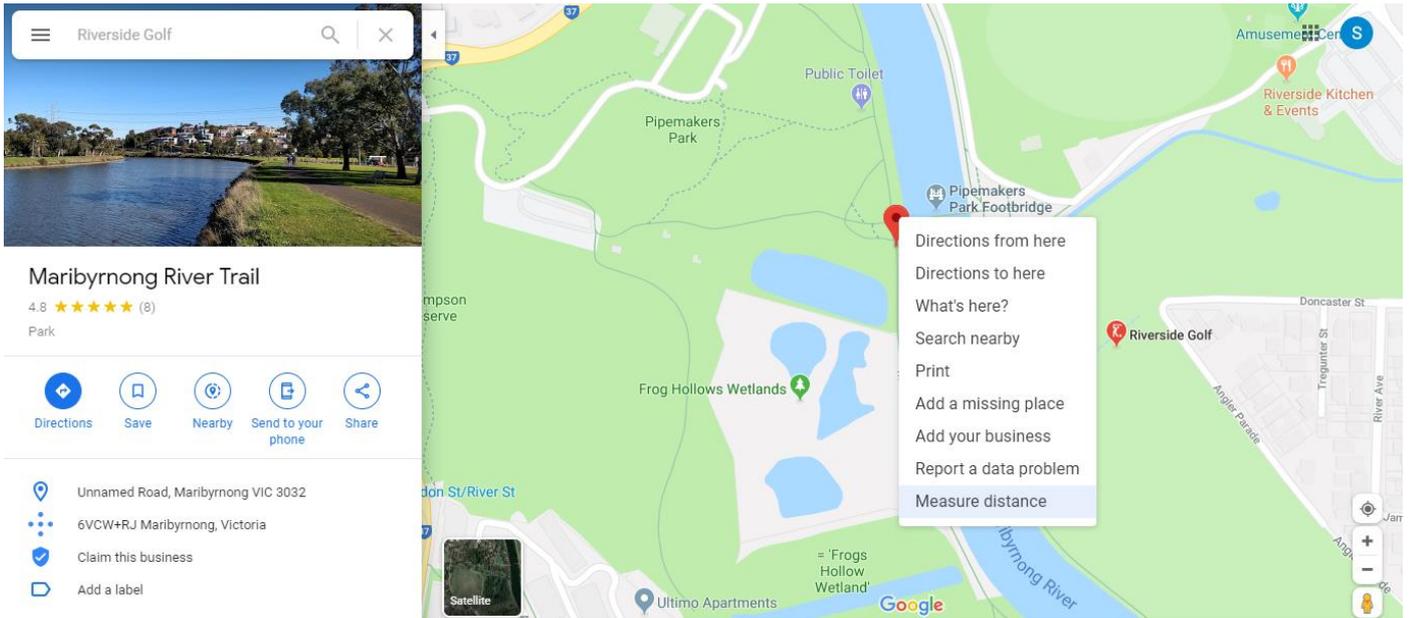
Add point

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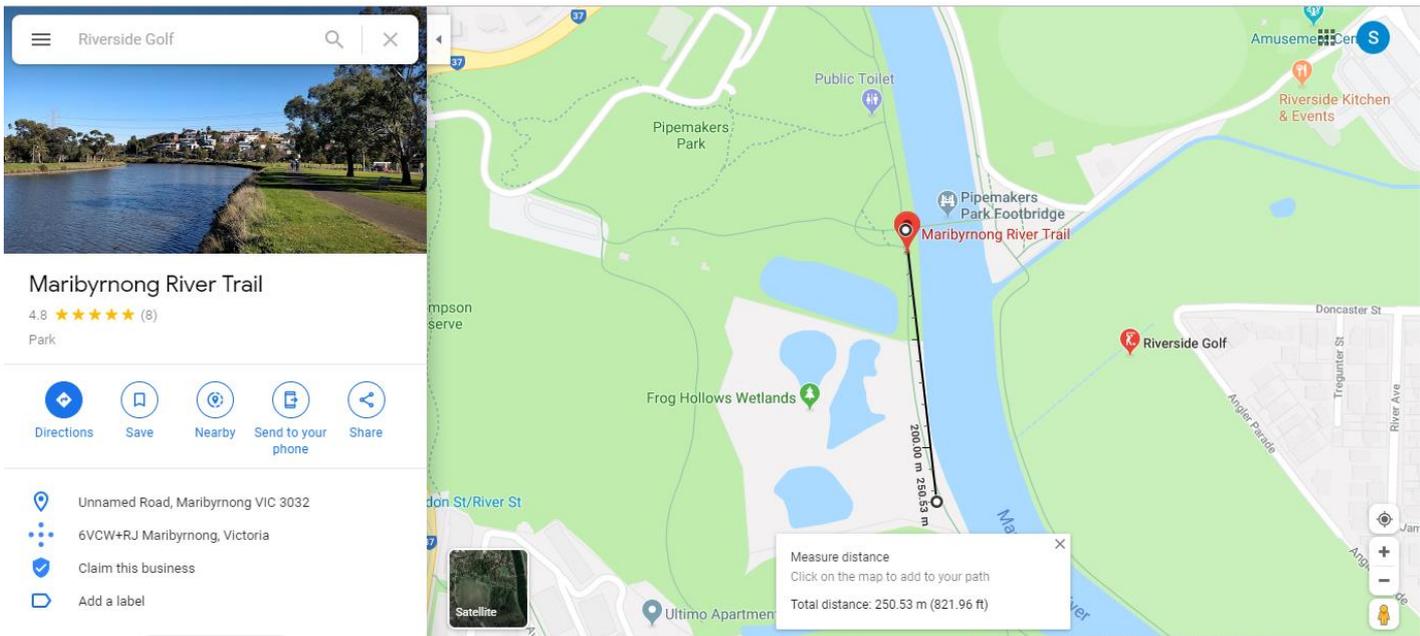
Appendix 3

How to measure distance on Google Maps (internet)

Right click on dropped pin and select 'Measure distance'.



Click another location on the map and distance will show in the box.



Continue adding locations to measure the full distance. Total distance is displayed in the box.

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