Georges Riverkeeper

Water... WOW!

STAGE 3 EDUCATION

Module 8: Water Pollution

Most of the pollutants going into waterways now come from stormwater. Anything that goes down an outdoor drain is destined to end up in the local waterway. These pollutants effect the environment and humans.

In this module, students will:

- investigate the types and causes of urban stormwater pollution
- learn how human activities can result in water pollution
- predict what pollutes water bodies
- identify and dramatise ways to stop water pollution

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Module 8: Water Pollution

Stage 3 Drama | Stage 3 Geography | Stage 3 Science | inside | linkage concept: branching

Teacher Background

Sources of water pollutants (GE3-2 explains interactions and connections between people, places and environments)

Branching is used as a linkage concept that will reappear throughout *Georges Riverkeeper Stage 3 Education Modules*, here in the context of pollution entering river and stream networks. Each time that branching is mentioned through the modules, ask students to reflect on how branching networks through which water-based substances flow contribute to carrying materials from one place to another. Repetition of this concept should reinforce the importance of the ability of water to carry substances through networks, which is one of the main reasons that water is so important for people.

Recall the branched networks of blood vessels within our body, streams across catchments, urban distribution infrastructure and tree roots through which water flows through, which were mentioned in previous modules. Because water flows through networks, it can carry useful substances from one place to another, but it also does the same with pollutants.

In *Module 6: Living Things in Water* and *Module 7: Aquatic Food Webs & Life Cycles*, students learned that plants and animals are adapted to particular environments. Given that adaptations evolve over many generations, it is not possible to instantly adjust to enable survival if there are large changes in an environment, such as occurs when forest is converted to an urban landscape. As explained in *Module 5: Water for Living Cities*, this alters the water cycle and dramatically increases the pollutant loads in waterways.

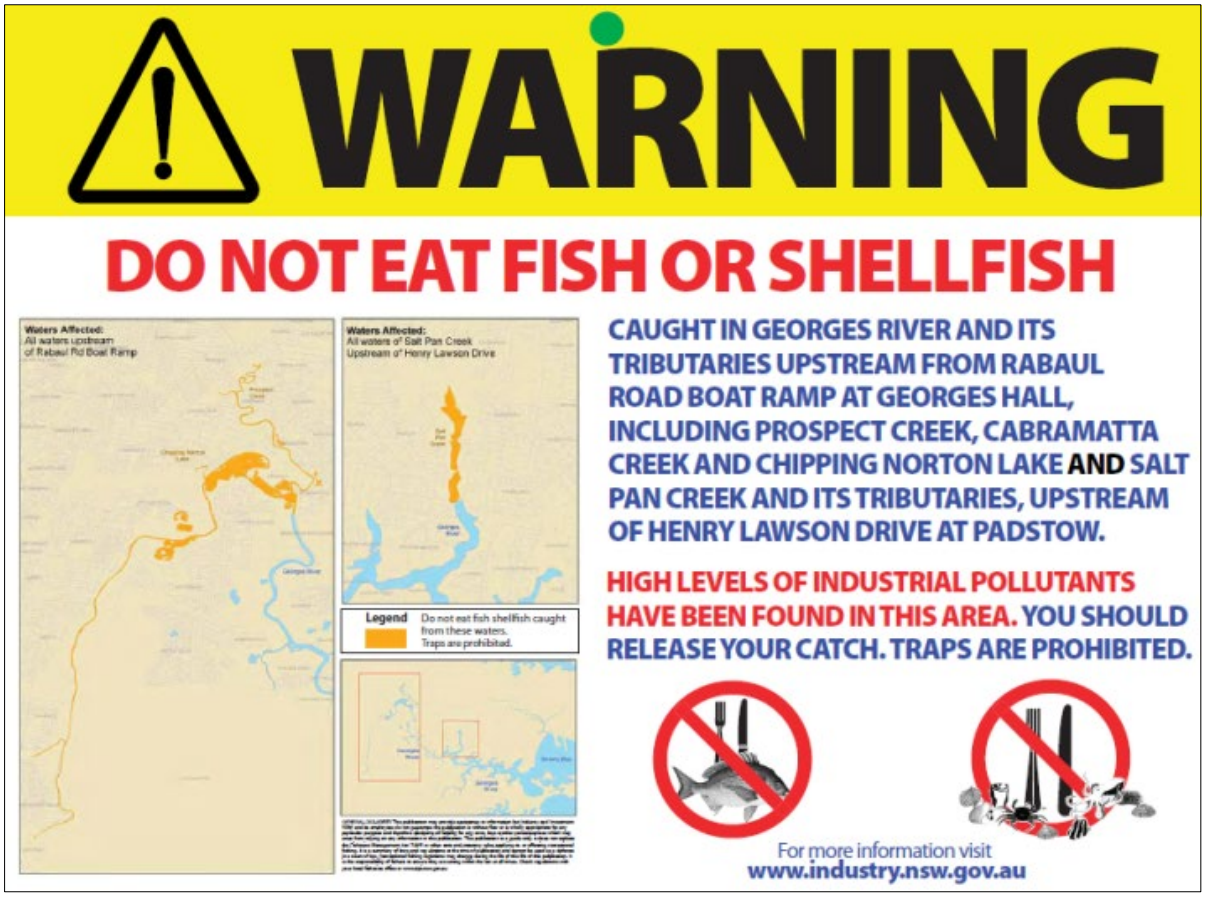
There is a common misconception that most water pollution comes from industrial discharges. There was far more untreated industrial pollution entering waterways prior to the 1970s than there is today, with the idea that 'the solution to pollution is dilution'. However, it became increasingly evident that waterways were being overwhelmed by industrial pollutants. Regulations were introduced to reduce the amount of industrial pollutants entering waterways. There are still some legacies from earlier practice of discharging untreated industrial pollutants directly into waterways, e.g. heavy metals bind to sediments and have accumulated in river beds.

Most of the pollutants going into waterways now come from stormwater. Over 90% of the pollutants entering the Georges River come in stormwater. Remember that water is very good at transporting materials that float and in solution. Also recall the branching networks of streams which converge and form larger rivers: so streams are able to collect pollutants from a broad area across which the branching network spreads. In urban areas, stormwater runs across hard surfaces that have minimal filtration capacity. Stormwater picks up oils, detergents and tyre residue that runs off roads; fertilisers, pesticides and lawn clippings that run off lawns and gardens; sediment that runs of poorly maintained construction sites; and, any other pollutants that are thoughtlessly disposed of down outdoor drains. Water flowing through stormwater systems made from concrete (including stormwater channels and underground pipes) picks up more pollutants that dissolve from concrete. The drain is for rain! Anything other than rain that goes down outdoor drains is a pollutant.

Unlike the water flushed down our toilets or going down indoor sinks into the sewage system, water that enters the stormwater system is not treated before being discharged to waterways. So, anything that goes down an outdoor drain is destined to end up in the local waterway. Water in sewage systems travels to treatment plants for purification prior to discharge. But, sometimes there are leaks in the pipes of sewage systems that introduce pollutants into waterways. For more information about pollution in the Georges River see the factsheet.

Effects of Pollution (ST3-4LW-S Examines how the environment affects the growth, survival and adaptation of living things, GE3-2 explains interactions and connections between people, places and environments, GE3-3 compares and contrasts influences on the management of places and environments.)

As mentioned above, there are many different types of pollutants that enter waterways. These pollutants have many different effects, including damaging natural environments and also reducing opportunities for human uses. The Georges River can be used as a case study to show how effects vary across a river. In the upper river, the river flows through natural forest and supports highly diverse communities of native plants and animals. The water is clean, safe for swimming and even for drinking with minimal additional treatment (e.g. the Woronora Dam captures water for household use). However, there is much urban development around the streams that enter the middle of the river. Those streams receive much stormwater. Weeds thrive with the nutrients supplied in stormwater, but there are few native animals that can survive in such polluted water. It is not safe to swim in the polluted water and it is certainly not safe to drink it. Given the high concentrations of pollutants that may be accumulated in the bodies of fish, there are warnings that fish captured from the middle reaches of the river should not be eaten (see below). At the bottom of the river, tides do a reasonable job of flushing out pollutants in water (reflected in improved grades for water quality on Report Cards). It is possible to swim and eat fish captured towards the bottom of the river, but many native species struggle to cope with water pollution and other pressures from human developments impacting the lower river and Botany Bay. For example, Captain Cook first named the bay 'Stingray Bay' owing to frequent stingray sightings, but stingrays are now a rare sighting. Botany Bay was known as a highly productive estuary for fishing in the 1880s, but commercial fishing ended in 2002 and native fish are not as abundant as they were historically. Also, Georges River once supported one of the most highly productive oyster cultivation industries in NSW, but that industry was decimated by pollution and disease.

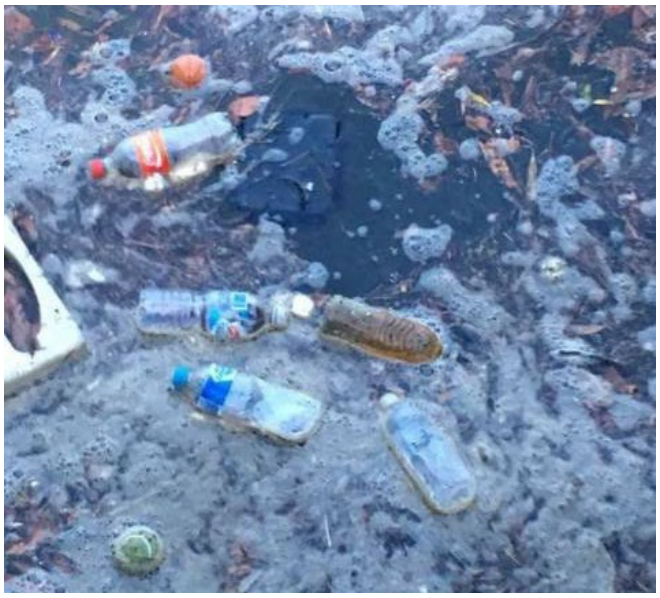


Sequence for Module 8: Water Pollution	
Syllabus Outcomes	**ST3-4LW-S** Examines how the environment affects the growth, survival and adaptation of living things. **GE3-2** Explains interactions and connections between people, places and environments. **GE3-3** Compares and contrasts influences on the management of places and environments. **DRAS3.3** Devises, acts and rehearses drama for performance to an audience.
Learning Intentions	For students to: ♦ define 'stormwater' ♦ investigate the types and causes of urban stormwater pollution ♦ how human activities can result in water pollution ♦ predict what pollutes water bodies ♦ identify & dramatise ways to stop water pollution
Teaching & Learning Activities	Inquiry Question: *How does stormwater affect our environment?* ♦ Students define the term 'stormwater'. **GE3-2, GE3-3** ♦ Students investigate the types and causes of urban stormwater pollution. Where do stormwater pollutants originate from? What are the various sources of stormwater pollutants? (e.g. fuel and oil on roads, litter, sediment from building sites, garden clippings & leaves, dog droppings, fertilisers & detergents). How is stormwater pollution harmful? How can we prevent it? This hands-on water pollution activity may be undertaken by the teacher for students to predict what pollutes water bodies and to identify ways to stop water pollution. **GE3-2, GE3-3** ♦ Once pollutants enter our waterways, what happens next? How does pollution affect aquatic animals and their food source? Students watch the video Toxic Silt in Sydney Harbour (2:58) and discuss the impacts of contaminants in our oceans. How do toxins in the food chain affect us? (It is suggested that teachers provide a copy of the video transcript to students to tackle unfamiliar terms and unpack the content).**GE3-2, GE3-3, ST3-4LW-S** ♦ Use the 'Playground fact' to reinforce that plastic pollution entering our waterways is a major issue that requires a solution. ♦ Students plan and present a dramatisation that effectively highlights how pollution can enter our waterways, as well as promoting ways to prevent water pollution. **DRAS3.3**
Resources	> Water pollution activity https://www.watercorporation.com.au/home/education/teaching-resources/find-a-lesson-plan/lesson-plan/water-pollution > Toxic silt in Sydney Harbour http://education.abc.net.au/home#!/media/30105/

Feedback	Your feedback is important to us. Please complete this quick online survey: http://bit.ly/ModulesFeedback

Playground fact:

Over 300 million tonnes of plastic is produced every year, about 100 million tonnes of which ends up in the environment and does not decompose. The litter we produce is the equivalent of dumping a full garbage truck of plastics into the ocean every minute of the year. By 2050 the weight of plastic in the ocean is predicted to be more than the weight of fish in the ocean.



Biographies of authors

Dr David Reid

David is a scientist who studies waterways for his work at Georges Riverkeeper in southern Sydney. He grew up near Lake Macquarie and the beaches south of Newcastle, where he spent much time swimming, surfing, exploring the life in water and generally enjoying being close to water. After finishing school, he went to university and his studies eventually led to completion of a PhD on waterbugs and food webs in farmland streams. Gaining those qualifications has allowed him to do research and monitoring work in waterways around the world, including those in New South Wales, Victoria, South Australia, New Zealand and New York City (see https://www.researchgate.net/profile/David_Reid15). He still enjoys having fun in water too!

Antonina Fieni

Antonina loves rivers. She is often seen paddling up rivers and creeks looking for Eastern water dragons or sacred kingfishers. When not paddling, Antonina is teaching environmental science and geography at the Georges River Environmental Education Centre and at the Field Study Centre at Sydney Olympic Park. Her qualifications include a Bachelor of Education and a Graduate Diploma in Environment.

Acknowledgements

Georges Riverkeeper was established in 1979 and is a waterway management organisation located in southern Sydney that is dependent upon funding from member councils. Thank you for funding and other support to Bayside Council, Campbelltown City Council, City of Canterbury Bankstown, Fairfield City Council, Georges River Council, Liverpool City Council, Sutherland Shire Council and Wollondilly Shire Council. Any opinions expressed in these modules are those of the authors, not Georges Riverkeeper or member councils.

Thank you to Beth Salt and Nathan Varley for reviewing the modules and providing suggestions for improvements prior to their release. Thank you to Georges River Environmental Education Centre and local schools for helping with development of the modules, using the modules and providing feedback to improve the modules.

Thank you Creative Commons (https://creativecommons.org/), from which most images were sourced.

January 2020

Authorised and published by Georges Riverkeeper

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Georges Riverkeeper is an alliance of Councils with collective responsibility for the Georges River and its catchment.
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