stormwater education manual

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1. Stormwater versus wastewater

Summary

Students identify the wastewater system and the stormwater system at their school/home. They learn that wastewater is treated before being discharged or reused, while stormwater enters our waterways untreated.

CSF Learning Outcomes

SOSE	Geography 4.3, 5.1
Science	Chemical Science 4.1
	Chemical Science 5.2

Aim

Students will understand the differences between stormwater and wastewater.

Materials

- Activity sheet 1: Stormwater or wastewater
- NSW EPA poster

Advanced preparation

1. Obtain a copy of NSW EPA's stormwater poster. Contact your local Waterwatch Co-ordinator.
2. Photocopy the activity sheet for each student or small group.

Activity

1. Take the students to different rooms in the school to trace water from a tap to a sink to a pipe, and from a toilet cistern to a toilet bowl. Discuss where students think these pipes go.
2. Using the EPA poster, trace the wastewater system pipes from a tap/toilet to the treatment plant to the beach outlet.
   At the wastewater treatment plant pollutants are removed to strict standards set by the Environment Protection Authority (EPA) before the treated water is discharged. In rural areas where homes and buildings are not linked to a wastewater treatment plant, wastewater is piped to an underground septic tank located near each building.
3. Take the class outside on a walk around the school building, taking note of the different pipes. Ask students where they think these pipes go. Use the EPA poster to show the path of the stormwater system.
   Spouting and downpipes on the outside of buildings take water to the stormwater system. The pipes from the drinking taps and toilets take water and waste to the treatment plant.
4. In class, students complete activity sheet 1. Check they have coloured the pipes and shown the water flow correctly, and can explain the difference between wastewater and stormwater.
   The stormwater system carries rainwater. The wastewater system carries used water and solid wastes to a treatment plant (or septic tank) where the water is made clean again.

Extension

Students draw a picture of their home to show how rain falling on their roof enters the stormwater system. They label the different parts of the stormwater system.

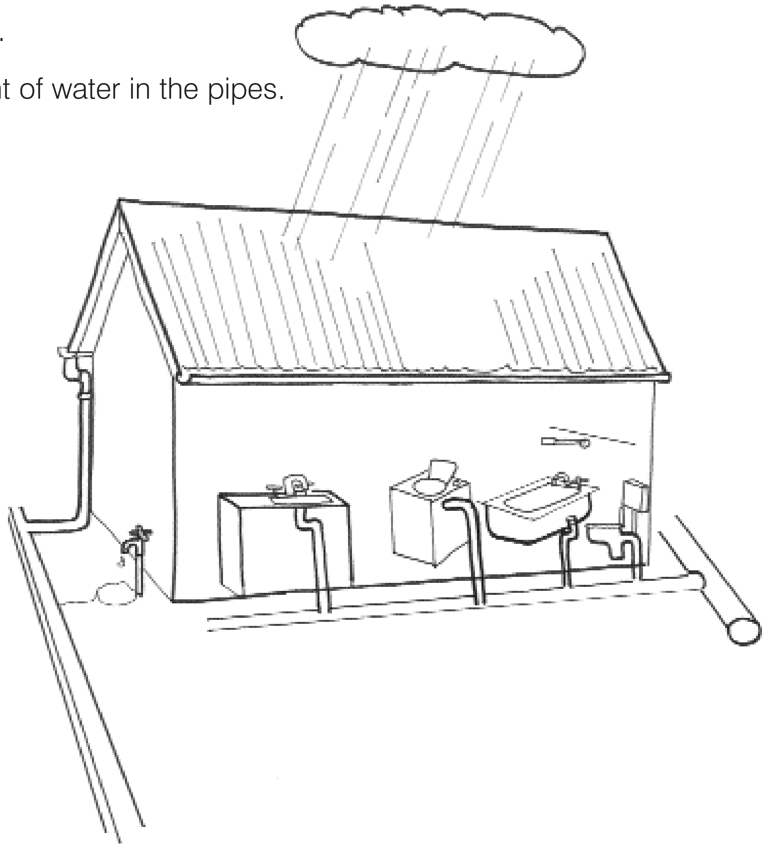
Activity 1 - Stormwater or wastewater

Look at the pipes inside and outside the house shown below. The pipes from inside the building take water and solid waste to a wastewater (sewage) treatment plant. The pipes on the outside of the house take the water from the roof into the stormwater system.

Colour the wastewater pipes blue.

Colour the stormwater pipes yellow.

Draw arrows to show the movement of water in the pipes.



What is the difference between stormwater and wastewater systems?

2. Finding out about stormwater systems

Summary

Students identify parts of the stormwater system from gutter to final outlet. They investigate what should and should not go down the stormwater system.

Learning Outcomes

SOSE	Geography 4.1, 5.1
Science	Chemical Science 5.2

Aim

Students will understand the different parts of the stormwater system, what it is designed to carry, and where stormwater finally ends up.

Materials

- NSW EPA poster (see Activity 1)
- Information sheet 2: Where does stormwater go?
- Activity sheet 2

Activity

1. Use the EPA poster to introduce students to a basic stormwater system for a coastal town. Have students trace the poster's stormwater system to the beach outlet from 1) a roof top and 2) the street. Check they know the names of the different constructed parts of a typical stormwater system: downpipes, underground pipes, side entry pits, barrel drains, open drains.

2. Students complete activity sheet 2 to identify different parts of the stormwater system and some sequences in which they occur. As an alternative to using the cutouts, older students could write out their answers (e.g. as flow diagrams).
   The components of a stormwater system vary depending on the location of the town (coastal or inland), size of the town, past management practices (urban creeks may have been channelised), and the local drainage pattern (rainwater flows from land to waterways which eventually drain to the sea or an inland lake). A stormwater system may contain different combinations of variously sized pipes and barrel drains.

   Sample sequences for stormwater flow:
   1. Roof 2. Downpipe 3. Under-ground pipe
   4. Barrel drain 5. Open drain/channeled creek
   6. River 7. Sea.
   AND
   1. Path/road/paved area 2. Street gutter
   3. Side entry pit 4. Barrel drain 5. Creek
   6. River. 7. Lake.

3. In the past, factories piped their liquid waste directly into the nearby creek/river/beach. This is now illegal. Where should it go? Ask students to suggest reasons why.

   Stormwater is not treated. Liquid waste from factories should not go into the stormwater system - it should into the wastewater system or to a specially managed waste collection site. Factories must obtain a Trade Waste discharge agreement from the EPA, and they pay a fee for the treatment of their wastes at the local sewerage treatment plant. Toxic wastes need to be sent to special chemical collection sites.

2. Information Sheet: Where does the stormwater go?

Picture what happens when it rains in your town or city.

The rain falls onto roofs of houses, schools, factories, office buildings, sheds, shops and shopping malls. What happens to all that rainwater?

Most roofs have guttering along their edges and these carry the water into **downpipes** that lead from the **roof** and disappear underground.

Below ground, there's a pipe that leads from the building towards a nearby road where, still underground, it typically joins a bigger pipe called a **barrel drain** that runs underground alongside the street gutter (or roadside gutter).

If the rain falls on the road, path, driveway or any paved area, it flows to the nearest street gutter. At intervals along this gutter are pits (called **side entry pits**) which have a pipe at their base that connects to the underground **barrel drain**.

All the water that flows into the **side entry pit** therefore flows on into the **barrel drain** and is carried on to a nearby waterway, channel or the sea, depending on where you live.

When it rains, stormwater runoff can carry with it pollutants from around our school, homes and streets into our rivers, lakes or the sea - places we swim in and places that frogs, fish, platypus, seahorses or dolphins call home.

What is wastewater?

The wastewater system or sewerage system takes liquid and solid waste from inside our homes, schools and buildings to a treatment plant.

Wastewater is carried in a completely different set of pipes to stormwater.

Activity Sheet 2 - Stormwater systems

Cut out these illustrations of parts of the stormwater system.

Remember that water flows downhill to a creek or river and eventually ends up at an inland lake or the sea.

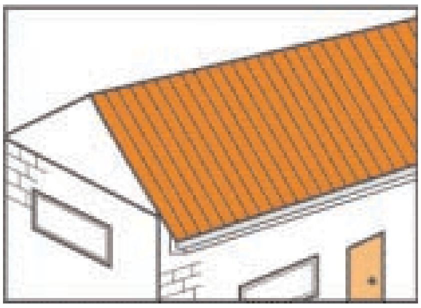
Use as many parts as possible to:

A. Place in order to show the direction of stormwater flow from a rooftop to the sea.

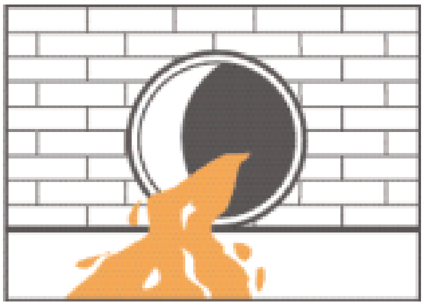
B. Place in order to show the direction of stormwater flow from a street to a lake.

C. Place in order to show the direction of stormwater flow from a rooftop to a lake.

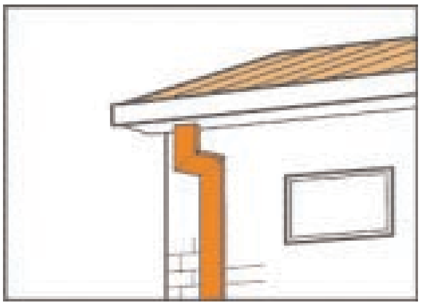
roof



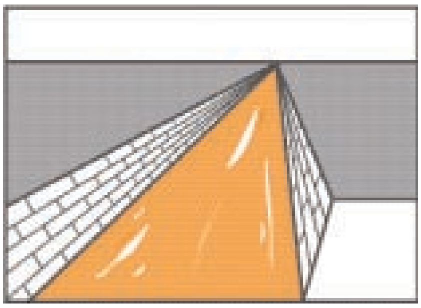
barrel drain



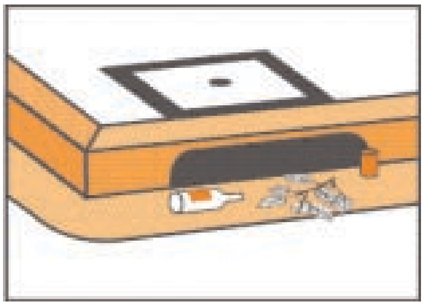
downpipe



open drain / channeled creek

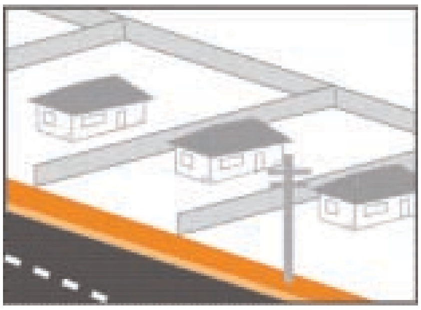


side entry pit



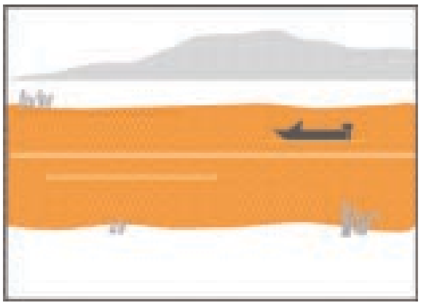
creek

street

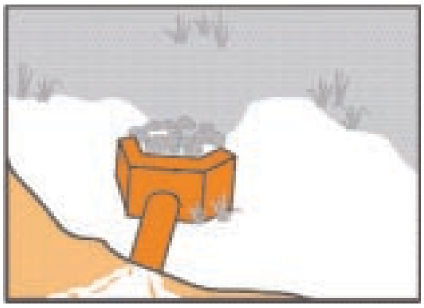


outlet to beach

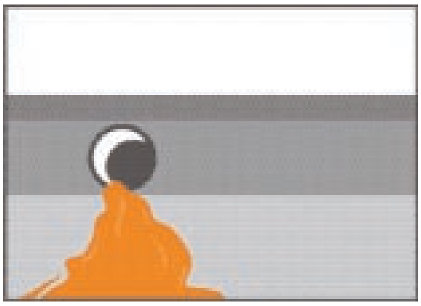
river



outlet to waterway



roadside gutter



3. Stormwater pollution traps

Summary

Students investigate the types of litter and pollution traps now being used within stormwater systems, and their advantages and disadvantages.

Note: You may first want to do Activity 9: Seen and unseen pollutants.

Learning Outcomes

SOSE	Geography 4.1, 5.1
Science	Chemical Science 5.2, 5.4
	Physical Science 5.4

Aim

Students understand that stormwater pollution is occurring and become familiar with a variety of stormwater pollution traps. They can explain some benefits and disadvantages of these different pollution traps.

Materials

- NSW EPA poster (see activity 1)
- Information sheet 3a: Pollution traps 1 (primary level students)
- Information sheet 3b: Pollution traps 2 (secondary level students)
- Activity sheet 3: Pollution traps

Activity

PRIMARY/INTRODUCTORY LEVEL

1. Using the EPA poster, students identify pollutants depicted and way that can get into the bay. Can they find two types of litter traps? Can they find some stormwater outlets that do not have litter traps?
2. Working in small groups, students read the information sheet: Pollution traps 1.
3. They identify the different pollutant traps in the EPA poster.
4. Ask each group to suggest one advantage and one disadvantage of having pollution traps in stormwater systems.

SECONDARY LEVEL

1. Working in small groups, students read information sheet: Pollution traps 2.
2. They identify the different pollutant traps in the EPA poster.
3. Working in small groups, students complete activity sheet 3.
4. Assign a different pollution trap to each group to prepare a brief presentation on its advantages and disadvantages (e.g. what pollutants it collects, what it costs in terms of installation and maintenance).
5. Each group delivers their presentation.
6. Describe a scenario and ask students to suggest advantages and disadvantages for different types of stormwater traps for the situation. Which pollution trap do they think the community might be willing to pay for via their Council rates?

See also

Activity 9: Seen and unseen pollutants.

3a. Information Sheet - Pollution traps 1

In some places, stormwater pollution has become so bad that pollution traps have been installed to try to stop some of the pollutants from entering waterways, beaches or bays. These traps act like filters or screens to remove **some** of the pollutants.

Pollution traps collect pollutants - they do **not prevent** pollution. The traps need to be regularly cleaned and the pollutants collected from within the traps must then be taken to a landfill.

Some types of stormwater pollution traps

Traps at the **entry** to the stormwater system:

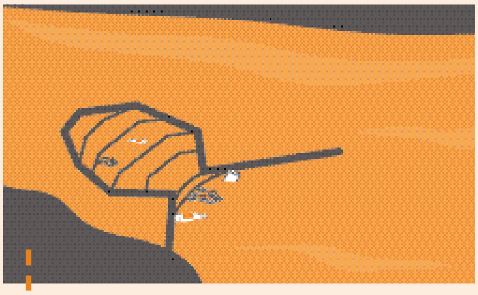
- Drainage entrance screens
- Side entry pit traps

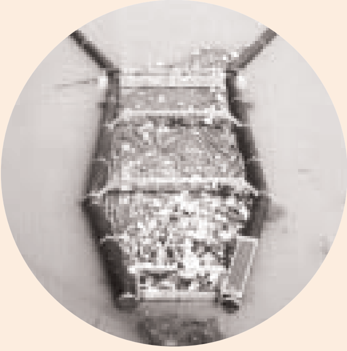
Traps **within** the stormwater system:

- Litter collection baskets
- Trash racks
- Floating traps on waterways
- Sediment basins

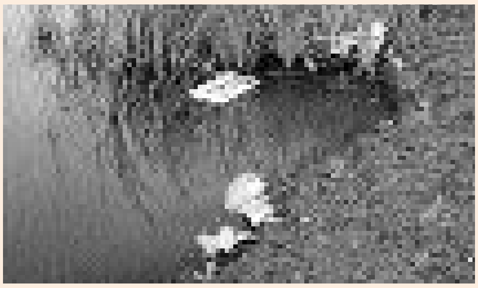
Traps at the **end** of a stormwater system:

- Artificial wetlands
- Sediment settling basins/ponds

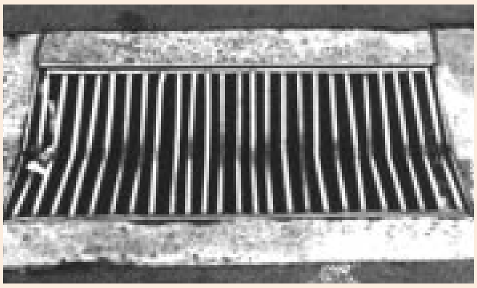




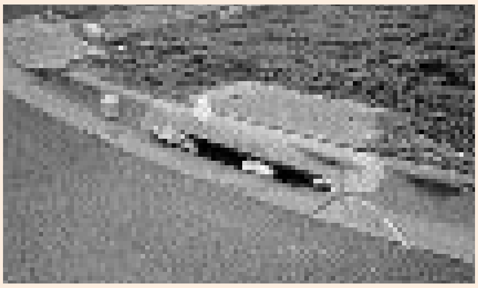
Floating traps on waterways



Artificial wetlands



Drainage entrance



Side entry pit traps

3b. Information sheet - Pollution traps 2

Some types of stormwater pollution traps

Traps at the **entry** to the stormwater system:

- Drainage entrance screens
- Side entry pit traps
- Filter strips
- Grass swales
- Porous pavements
- Infiltration trenches

Traps **within** the stormwater system:

- Litter collection baskets
- Trash racks
- Release nets
- Self cleaning screens
- Floating traps on waterways
- Sediment basins
- Infiltration basins

Traps at the **end** of a stormwater system:

- Artificial wetlands
- Sediment settling basins/ponds

What do the traps do and which pollutants do they remove?

PRIMARY TREATMENT (PHYSICALLY SCREEN)

These types of traps work by: 1) physically screening the pollutants out of the stormwater, or 2) causing the water to slow down so that the coarse sediments settle out of the water. These traps typically remove larger pollutants such as cans, bottles, plastics, leaves and twigs larger than 5 mm. They also generally remove coarse sediments larger than 0.5 mm in size (e.g. large sand grains).

SECONDARY TREATMENT (SETTLE AND FILTER)

This level of treatment uses a variety of methods to allow fine sediments to settle and be filtered out of the stormwater. These traps remove most of the finer particles and pollutants attached to them such as nutrients (phosphorus and nitrogen).

The settle and filter style traps typically remove finer sediments (much less than 0.5 mm in size), together with some of the pollutants (e.g. nitrogen and phosphorus) that attach to the fine particles.

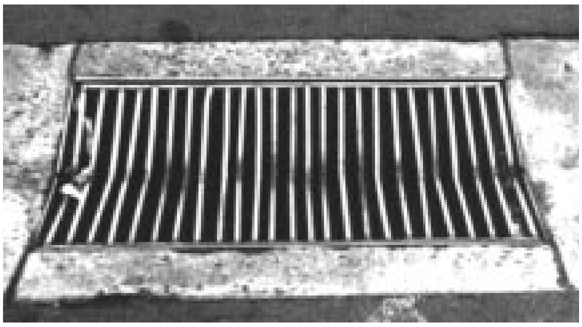
TERTIARY TREATMENT (ABSORPTION)

This level of treatment removes pollutants via natural biological processes within wetlands to absorb the nutrients. Wetland plants take up the nutrients into their roots, stems and leaves. In this way, wetlands remove nutrients and heavy metals. Wetlands (natural or specially constructed) also encourage sediments to settle within and around the wetland.

The primary and secondary treatment traps need to be cleaned and the collected pollutants taken to landfill.

A. Traps which try to stop pollutants entering the stormwater system

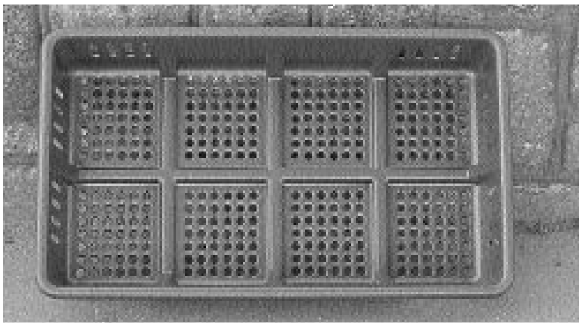
Grates and screens help to stop large pollutants such as leaves and rubbish (cans, bottles, plastics etc.) from entering the stormwater system. These are particularly useful at shopping centres and busy commercial centres that typically create lots of these types of pollutants. They also help to reduce drain blockages. They are inexpensive and easy to install, but they only keep large rubbish items out of the stormwater system. A street sweeper machine or Council maintenance worker needs to regularly collect and take away this rubbish.



Grate

Sediment trap

Side entry pit traps are wire or plastic baskets placed in a side entry drainage pit. They are also called litter collection baskets. Larger material in the stormwater is trapped as it flows though the basket. As the basket pores block up with material they can also trap some finer sediment. The material collected in the basket has to be regularly removed by hand or by a vacuum cleaning truck.



A litter basket placed inside a Side Entry Pit".

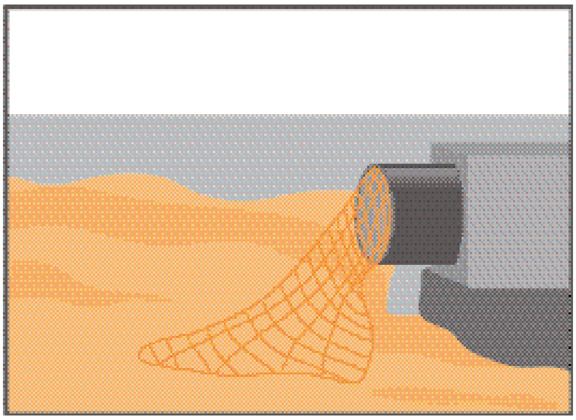
Sediment traps help separate sediment from stormwater. The simplest design is the 'swimming pool' type - a large shallow pool in which the water slows down and allows the sediments to settle. Sediment traps are also good to use at the entry to a wetland system as they remove the larger sediment particles. See 'Filter strips and grass swales' for more detail.

B. Traps which catch pollutants as they travel down the stormwater system

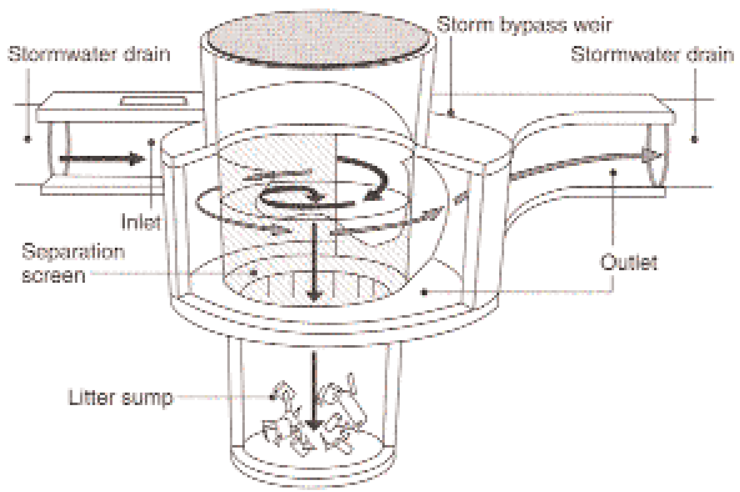
Traps can be placed within the stormwater pipe system to screen materials through a grid or mesh barrier. These include release nets, trash racks and self-cleaning screens.

A **release net** is a cylinder shaped net placed over the end of a stormwater outlet pipe. Gross pollutants collect in the net until the net becomes blocked. As the upstream water level rises this triggers a mechanism which releases the net from the drain outlet. The net detaches completely from the drain opening but is held to the drain by a short tether so it does not wash away. Release nets are relatively low in cost to install. They can be visually unattractive and smelly when full, and can be vandalised.

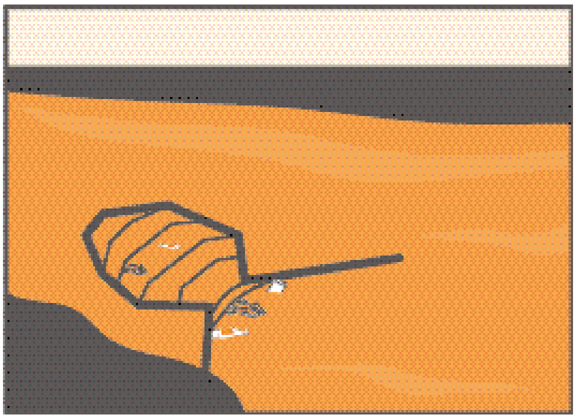
A **trash rack** is a physical barrier that can be installed in stormwater drainage channels to catch floating and submerged objects. They are usually made of steel bars spaced 40 - 100 mm apart. Once coarse material has built up behind the trash rack, finer material can also be collected. A trash rack and its trapped litter can be visually unattractive and smelly and it needs regular cleaning. If it is not cleaned often enough it becomes so blocked that the water level rises and flows over the top of the trash rack, carrying all the pollutants with it. Trash racks can be expensive (e.g. several hundred thousand dollars each) to install and maintain on a regular basis (e.g. thousands of dollars).



A **self-cleaning screen** (or circular screen) separates gross (large) pollutants from the incoming water and keeps them in a separate chamber. Solid items in this chamber are kept in continuous motion to stop them from blocking the screen. Heavier pollutants sink into a litter sump. Circular screens trap coarse and some fine sediment and can retain oils, so they remove many of the pollutants in stormwater. Because they are installed underground they do not create a visual impact. But they are expensive to install. They are cleaned by using either a vacuum pump or lifting the baskets(s) onto a truck. The collected material needs to be taken to landfill.



C. Traps installed in creeks and rivers



Floating traps were originally designed to retain oil slicks. Floating traps usually have partially submerged barriers which are fitted across part of a waterway, usually in a place where water flow is slow. They help remove highly visible floating pollutants, either by keeping them within the barriers or deflecting them to a holding chamber.

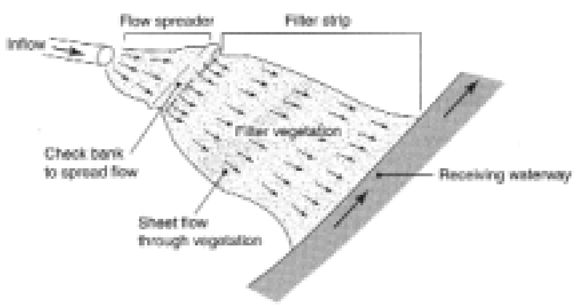
Floating booms collect the floating objects that collide with it. They work best with very buoyant objects such as plastic bottles and polystyrene and in very slow moving water. They do not catch submerged pollutants. They are relatively inexpensive but can be difficult to clean and maintain as this mostly needs to be done from a boat. Floating traps can appear unsightly and can break away during high flows.

D. Traps for removing sediments and attached pollutants

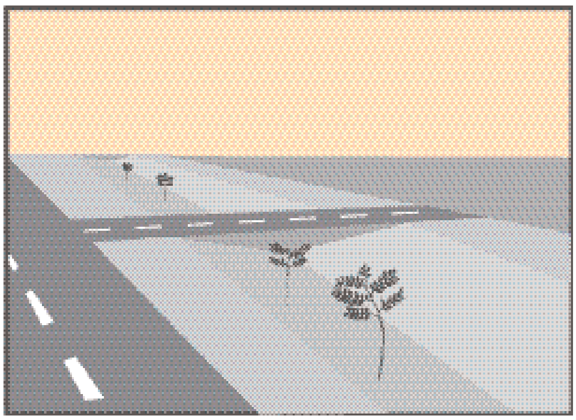
PRE-ENTRANCE TRAPS

Grass swales, filter strips (also known as buffer strips) and porous pavements stop some pollutants from entering the stormwater drains. They allow the water to flow over vegetation or a man-made porous surface, which encourages the water to soak into the soil and the sediment to settle out.

Filter strips are often located next to waterways and particularly help remove sediments and some pollutants attached to the sediment. The pollutants become attached to soil particles and organic matter in the filter strip. Some of the pollutants may be digested and processed by soil micro-organisms within the filter strip.



Grass swales are grass-lined channels used in streets that do not have a concrete kerb and gutter. They are sometimes used as a pre-treatment to other stormwater protection measures. They are similar to filter strips but also carry run-off. They can be used on road sides, road median strips, car park run-off areas, parks and recreation areas.

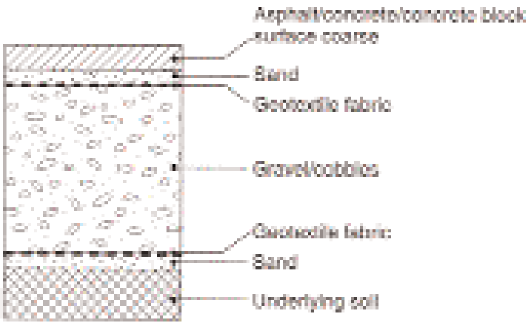


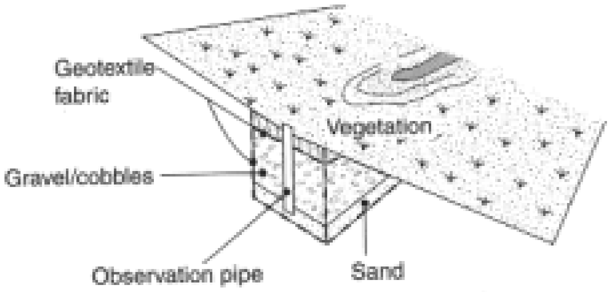
Car parking should not occur on the swale/filter area as this reduces the effectiveness of these areas for stormwater treatment.

Porous pavements allow water to soak through the surface rather than simply run-off as it would from concrete or bitumen. Porous pavements are made by 1) using paving bricks and leaving large 'gaps' between the bricks, or 2) by creating a deep layer of gravel over a layer of sand so that run-off can soak through the porous pavement into the gravel reservoir and the sand filter below. This allows particulate and some dissolved pollutants to be filtered out and absorbed onto soil particles.

Porous pavements can only cope with light traffic flows and only suit gently sloped sites. If the pavement becomes clogged, infiltration will be reduced.

An **infiltration trench** (bioremediation system) is a shallow, excavated trench filled with gravel or rock, which is located so that run-off drains into it. Stormwater then soaks through the trench into the surrounding soil or into a plastic pipe which takes the 'treated' water elsewhere on the site. Sediments and some dissolved pollutants stay in the trench. The trench is lined with a special type of fabric that stops the surrounding soil from getting into the trench. A shallow layer of topsoil and a layer of fabric cover the trench. These trenches can become clogged with sediment and pollutants. They are not suitable for use on steep slopes or in loose or unstable areas.





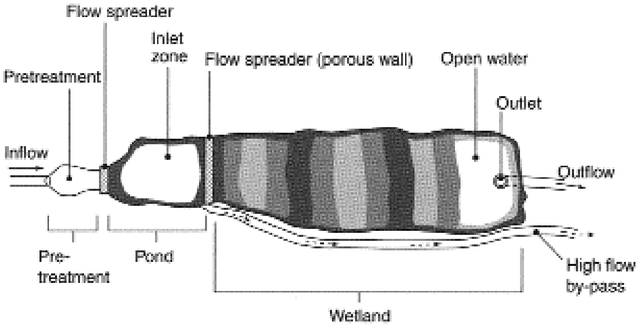
IN-TRANSIT DEVICES

Infiltration basins, extended detention basins and sand filters are used to reduce the speed at which stormwater flows over an area. Slower flows allow sediments to settle out and the water to filter through the soil, sand or gravel which lines the storage basin.

Stormwater **infiltration basins** are open excavated basins designed to hold run-off after heavy rain and reduce the rate and speed of water moving downstream. They remove sediment, and some dissolved pollutants as the stormwater filters into the soil and is absorbed onto soil particles. Infiltration basins need a large amount of land. This only works in some types of soil and not on steep slopes.

Constructed wetlands remove or retain nutrients and fine sediments. The wetland plants and bacteria and micro-organisms in them absorb some of the nutrients. To help them do this, wetlands are generally constructed so that the stormwater first flows into relatively deep pond (sedimentation basin) then flows into a shallow waterbody. This design allows wetland vegetation to easily grow and so helps prevent oxygen depletion. The wetland plants use up some of the nutrients collected in the sediments. Constructed wetlands also provide wildlife habitat, can improve the visual appeal of an area and help reduce flooding downstream. They do need a large area of land to be available and are expensive to construct.

Maintenance costs can be high as the accumulated sediment needs to be removed every three to five years. The wetland plants may need to be replaced and weed species removed.



Activity Sheet 3 - Pollution traps

Use Table 3: Stormwater pollution traps to identify:

- Traps for removing rubbish (bottles, cans, plastic bags etc).
- A trap which can remove dissolved pollutants.
- A trap that has a low installation cost.
- A trap that has a high installation cost.
- A trap that needs weekly cleaning.
- A trap that needs quarterly cleaning.
- A trap with high maintenance costs.
- A trap with low maintenance costs.

Is there a trap that removes all types of pollutants?

Complete the table below by referring to the Table: Stormwater pollution traps (next page), and the information sheets: Pollution traps 2.

	Trap size (large, medium, small)	What it traps	Installation Cost (high, medium, low)	Cleaning Costs (high, medium, low)
Entrance trap (grate)				
Side entry pit trap				
Release net				
Trash rack				
Floating				
Infiltration basin/wetland				

3. Table: Stormwater pollution traps

Type of trap	What it traps					Catchment area(ha)	Cleaning frequency	Installation cost	Maintenance cost
	Gross pollutants	Coarse sediments	Fine sediments	Attached pollutants	Dissolved pollutants				
Grates and entrance screens	Some	None	None	None	None	0.1 - 1	Weekly	Low	Low to Medium
Side entry pit traps	Some	Some	None	None	None	0.1 - 1	Monthly	Low to Medium	Low to Medium
Release nets	Most	Some	None	None	None	1 - 50	Weekly to Monthly	Low	Low to Medium
Trash racks	Some	Some	None	None	None	20 - 500	Monthly	Medium	Medium to high
Circular screens	Virtually all	Most	Many	Some	None	5 - 150	Quarterly	High	Medium to High
Floating traps	Some	None	None	None	None	More than 100	Weekly to monthly	Low	Medium to High
Filter strips and grass swales	Some	Many	Some	Some	Some	1 - 5		Low	Low
Porous pavements	Some	Many	Some	Many	Some	0.1 - 1		Medium	Low to Medium
Infiltration trenches	Some	Many	Some	Some	Some	0.1 - 5		Medium to High	Medium to High
Constructed wetlands	Some	Many	Many	Many	Some	10 - 100		High	High

Adapted from: *Urban Stormwater: Best Practice Environmental Management Guidelines* (Melbourne Water Corporation, 1999). CSIRO PUBLISHING.

4. Where can water flow?

Summary
This activity compares natural water flow in a local natural catchment with the urban drainage system

Learning Outcomes
SOSE Geography 4.1, 5.1, 5.2

Aim
Students will understand the similarities and differences between their urban drainage system and drainage in natural catchments.

Materials
- Activity sheet 4a: Where can water flow?
- Activity sheet 4b: Comparing natural and urban drainage catchments
- Local catchment map
- Coloured pens/pencils

Advance preparation
If desired, adapt the diagrams in the activity sheet to better reflect your local catchments (to show the mountains where your local river/creek flow from and sea or lake that this river/creek flows to).

Obtain a map to show the local catchment area in which your school is located (via your Local Waterwatch Co-ordinator or Council Officer).

Duplicate the required numbers of the activity sheets for small groups or individual work.

Activity
1. Distribute activity sheet 4a to students/small groups and make sure they understand all the terms used on the diagram. Ask the students to draw arrows on Diagram A: 'Natural catchment' to show several possible directions rain may flow once it falls from clouds above the mountains to a final location in the water cycle. They should use different coloured pens to show flow compared to infiltration.
2. Ask the students to imagine they are standing on the footpath outside the school (or actually do this outside if time permits). Where do they think rainwater goes when it falls on the footpath, road, lawns, gardens, school grounds around them? Students complete Diagram B: 'Urban drainage' by drawing in the arrows to show rainwater flow. As with Step 1, they should use different coloured pens to show flow compared to infiltration.
3. Distribute activity sheet 4b for students/small groups to complete to compare similarities and differences between natural catchment and urban drainage systems.

In a natural catchment:

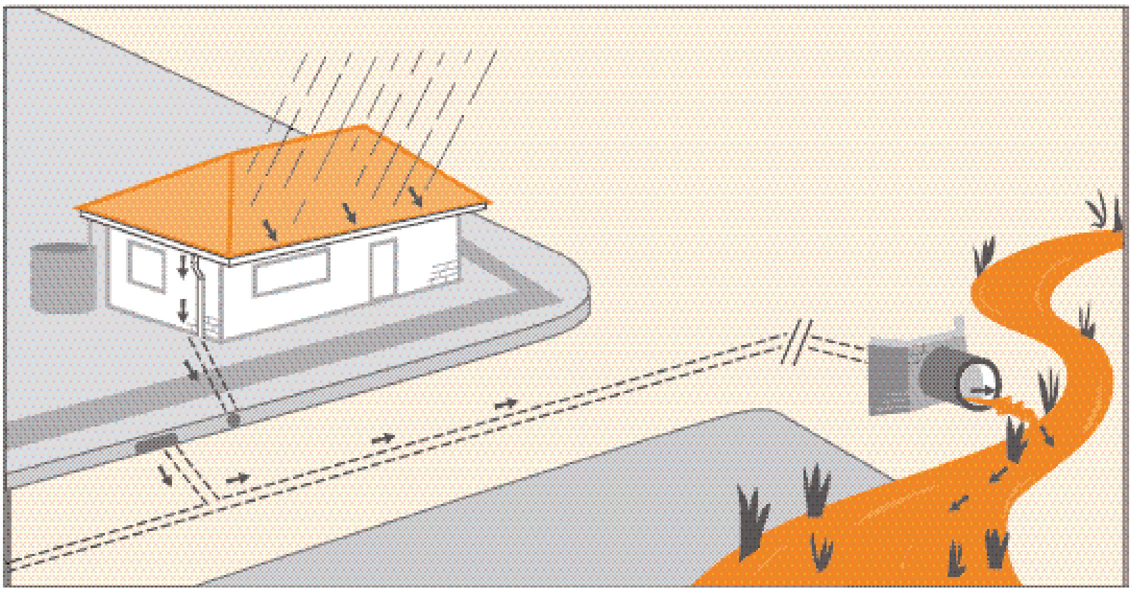
Water falls as rain.
It collects in puddles.
It runs down hillsides and slopes.
It flows over land only during a flood.
It flows in creeks and rivers.
These empty into a sea or lake.
Some water infiltrates into the ground.

In an urban catchment:

Water falls as rain.
It collects in gutters.
It runs down off roofs.
It flows over paths and bitumen.
It flows in underground pipes.
These empty into the local creek.
Some water infiltrates into the ground.

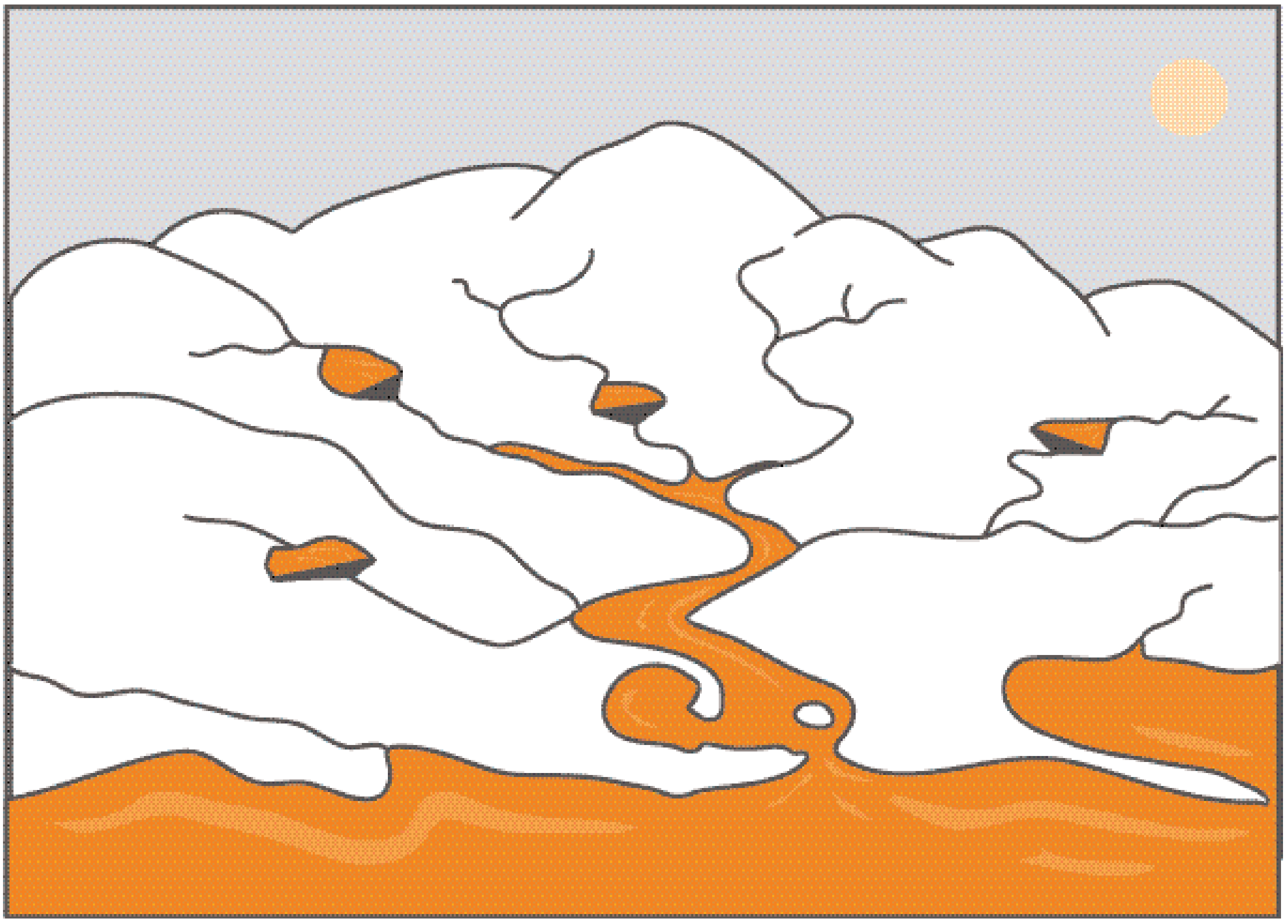
Acknowledgement

Adapted from Wimmera Junior Landcare Stormwater Education Project by Jeannie Clarke. 2001.

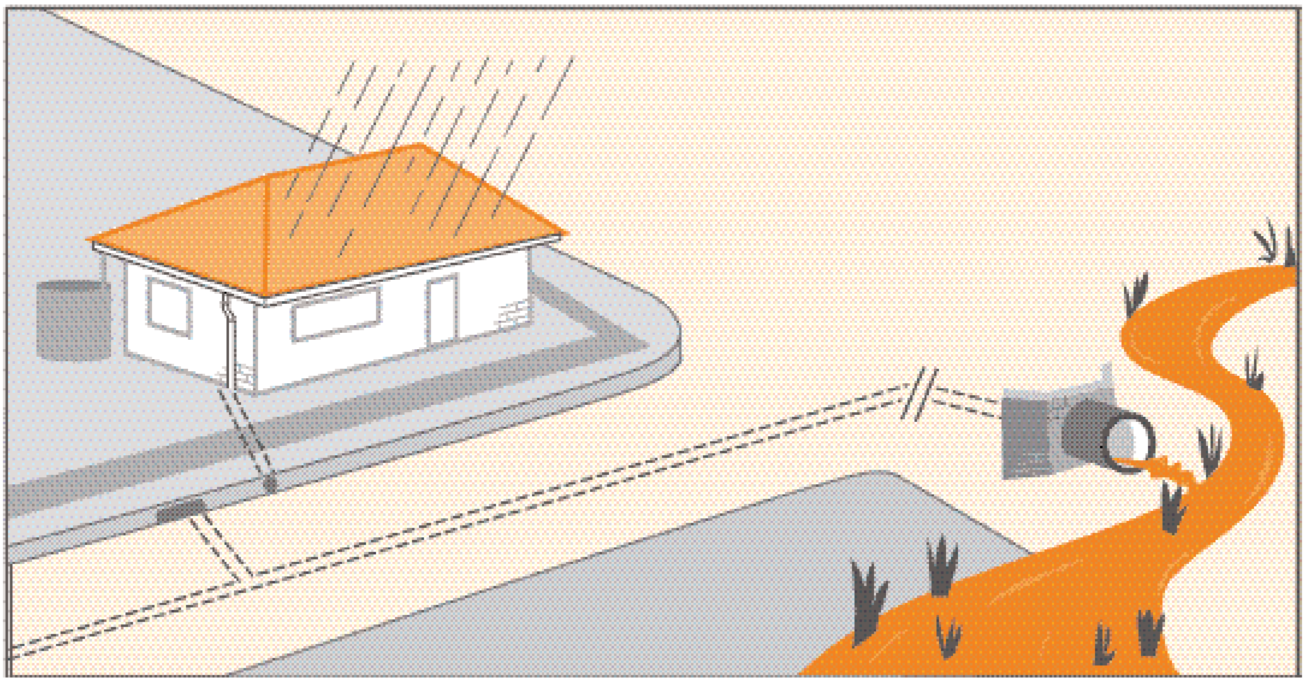


Activity Sheet 4a - Where can water flow?

A: Where does water flow in a natural catchment?



B: Where does water flow in a urban catchment?



Activity Sheet 4b - Comparing natural and urban drainage catchments

Water action in the catchment	(1) In a natural catchment	(2) In an urban catchment
Water falls as		
It collects in ...	puddles	
It runs down ...		
It flows into ...	creeks and rivers	
It flows ...	over land only during a flood	
These empty into ...		
Some water infiltrates into		

Complete the above table using the following words, trying to find the right match for column 2 and column 3. A few examples have been filled in. Some may need more than one of the following options.

A sea or lake	Over paths and bitumen
Drain entry pits	Puddles
Drain outlet	Rain
Ground	Rainwater tanks
Gutters	The local creek
Hillsides and slopes	Town water
Off roofs	Underground pipe

5. Stormwater transport and flooding

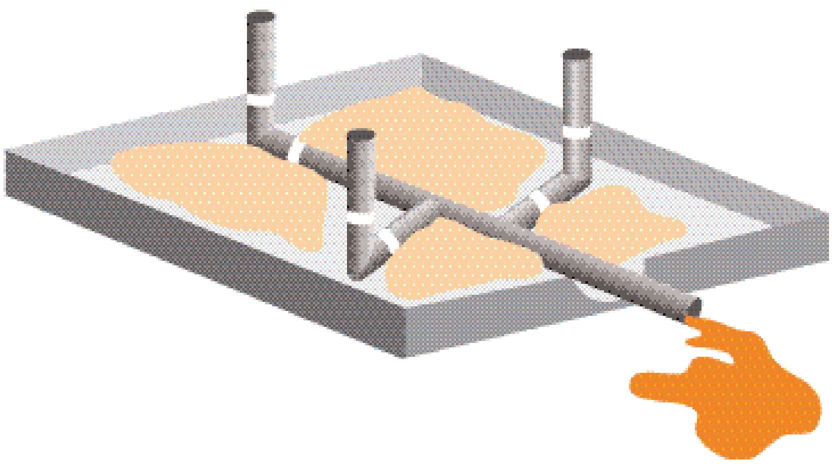
Summary
Students create a model stormwater system in a sand pit.

Learning Outcomes
SOSE	Geography 5.2
Science	Physical Science 4.2, 5.4

Aim
Students will understand what happens in stormwater systems in high rain events and will understand what impact illegal connections have on stormwater systems and the waterways and bays they drain to.

Materials
- Sand pit
- Lengths of poly pipes (two sizes e.g. 30mm and 15mm) and joiners as per diagram
- Insulation tape
- 'Pollutants' in separate buckets of water, e.g. 1) one bucket with small pieces of torn paper, 2) one bucket with water with food colouring, 3) one bucket with small balls of clay (no bigger than 10mm)
- Water
- Information sheet 5a: Moving pollutants
- Information sheet 5b: Illegal connections

Advanced preparation
Collect the materials needed for the activity.



Activity

STORMWATER FLOWS

1. Take some of the sand out of the sand pit so that the pipes can be laid under the sand. Using the poly pipe, create a network of pipes to simulate pipes taking stormwater from houses to a waterway or bay (see sketch). Each pipe join must be taped using waterproof tape such as insulation tape. Bury the network, leaving all the entrances to the stormwater pipes available for simulated 'rain' to enter.
2. Sprinkle clear water down the stormwater pipes to simulate a light rainfall. What happens? Then, one at a time, add the 'pollutants' from the buckets to simulate heavier sprinkling of rain. What happens?
3. Discuss where the 'pollutants' could have originally come from.
4. Ask to students to explain how this demonstrates 1) how pollutants get from streets and roofs to beaches, 2) why flooding sometimes occurs near stormwater drains after heavy rains.
5. Students use the demonstration to explain how litter on a beach is usually caused by people far away from the beach.

ILLEGAL CONNECTIONS

1. Use the poly pipe to simulate a network of pipes illegally connecting house roofs to sewerage systems. Again, each pipe must be taped using waterproof tape such as insulation tape. Make it clear to the students that this time the 'outlet' at the end of the pipe represents a sewerage treatment plant.
2. In this case the two side pipes represent illegal connections to the sewerage system. Bury the network, leaving the entrance to all the pipes available for simulated 'rain'. Pour water down all the pipes simulating a heavy rainfall. What happens? Remind the students that in this case the 'flooding' they see is actually sewerage! What problem do illegal connections therefore cause?

   This process quickly demonstrates flooding and the pressure created by the heavy water flow.

3. Brainstorm possible solutions to this problem.

   Examples include:
   - An education/awareness-raising program.
   - The local Council/Melbourne Water could create a regulation against illegal stormwater connections.
   - The local Council/Melbourne Water could set and enforce fines for illegal connections.

5a. Information Sheet: Moving Pollutants

When it rains heavily for long periods, lots of water runs off our roofs, gardens and roads. Although it disappears into a pipe or a side entry pit along the road, the water flows to a nearby waterway and in many cases it eventually reaches the sea.

This stormwater collects dirt, grime and litter that may have been lying on our roof, in our garden or in the street. It may collect things we leave on the nature strip outside our house. This includes leaves and sticks, fertiliser and dog droppings.

All this water and its collection of pollutants eventually flows to the river or the bay, adding the stormwater and its pollutants to the aquatic environment.

One serious problem is that high *E. coli* levels often occur at beaches during or shortly after heavy rainfall. *E. coli*is a bacteria carried in human and animal waste. High levels of *E. coli* indicate the water is not safe for swimming.

Dry weather side-entry pit

After heavy rain

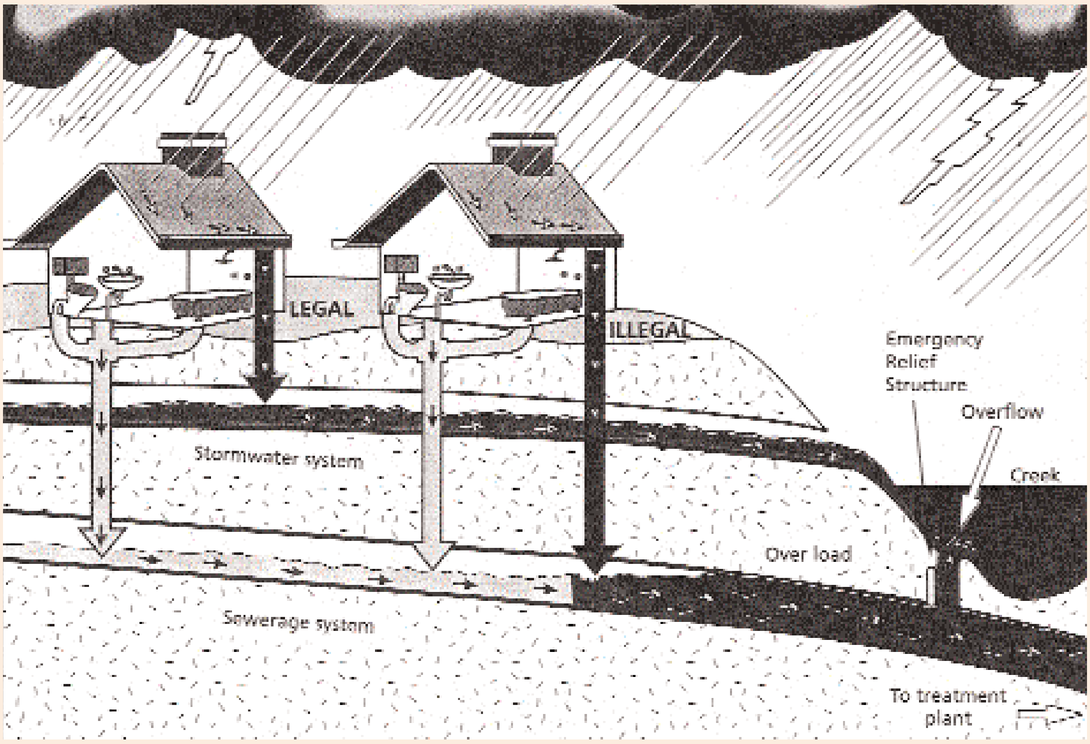
5b. Information Sheet: Illegal connections

Sewerage systems are not designed to transport huge flows of water - they are designed to transport liquid wastes from homes and industries to a treatment plant.

Problems can occur in urban centres if stormwater pipes are connected, illegally, to the sewerage system. The downpipes from roofs should be connected to the stormwater system, not to the sewerage system.

Just a few buildings with illegal stormwater connections can cause huge additional amounts of water to enter the sewerage system after heavy rain. When this happens, the sewerage system can become overloaded with the result that sewage overflows into the local waterway or bay.

Illegal connections cost the community hundreds of millions of dollars each year in additional treatment of contaminated waterways and beaches and in lost amenities (e.g. beaches closed to swimmers because of health risks associated with the polluted water).



REPRODUCED WITH PERMISSION FROM: BACKYARD TO BAY CATCHMENT IMPACTS: THE URBAN WATERWAY CHALLENGE. MELBOURNE WATER AND MELBOURNE PARKS AND WATERWAYS, 1993.

6. Changing times

Summary

Students create a presentation to explain how stormwater drainage has changed over the last century, then take part in a quiz.

Learning Outcomes

SOSE Geography 5.2, 5.3

Aim

Students understand how and why stormwater infrastructure has changed over the last century with increasing populations and urbanisation.

Materials

- Information sheet 6: *Changing times*

Advanced preparation

Duplicate the information sheet for small group work.

Activity

1. Distribute a copy of the information sheet *Changing times* to small groups.
2. Working in small groups, or individually, students prepare a presentation (e.g. Powerpoint, posters, or illustrated timeline) to explain how and why stormwater infrastructure has changed over the last century or more.
3. Each group/student makes their presentation to the class.
4. Conduct the quiz to see which group can answer the most questions correctly, or give the best answer to a question.

Sample quiz questions:

True/False:

Q. When they were first put in place, the main purpose of stormwater drains was to reduce flooding after heavy rain.

Q. Urban creeks were made into concrete drains so they would look better.

Q. Urban creeks and rivers rise more rapidly after rain today than they did 100 years ago.

Q. Urban run-off carries more kinds of pollutants today than it did 100 years ago.

Explain why:

- Explain why today more rainfall turns into **run-off** in a city/town, rather than soaks into the soil, compared to 100 years ago.
- Explain why there's more run-off and it **flows faster** in a city/town today compared to 100 years ago.
- Explain why many people no longer want urban creeks to be made into concrete drains.

Students could make up more True/False questions for the quiz.

6. information sheet: Changing times

In the past, the main function of the stormwater drains was to **reduce flooding** after heavy rain. The drains were put in place to carry the rainwater quickly from the streets to waterways to try to prevent houses, shops and factories from flooding. In fact in town and cities, some creeks were straightened and concreted (channelised) to become in effect a concrete drain that would carry stormwater away quickly.

Several decades ago most people were unaware that stormwater also carried large amounts of pollutants and so did not realise the impact of stormwater on the waterways and bays. Today, more people understand the role of waterways as **habitat** for native animals and more people use waterways and bays as **recreation areas** and so do not want these areas polluted.

Since those early days of stormwater drainage, several things have changed. More areas are now heavily urbanised - which means more land is covered with **impervious** surfaces such as bitumen, concrete and buildings. (Impervious means that water cannot seep through it.) As a result, with so much impervious area in towns and cities, much less rain can now soak directly though the soil, and instead has to flow down streets and roads as **run-off**.

Along the way this run-off picks up pollutants from our paths and roads. The **amount of pollutants** now picked up by stormwater runoff has greatly increased because there are many more people and pets, and because we use more chemicals and use our cars more often. This means that stormwater run-off in the last decade for example carried larger amounts of pollutants to waterways and bays than it did a century ago, and as a consequence, some waterways are under greater threat.

7. Where does your stormwater go?

Summary

Students walk along a nearby section of river or beach, taking particular notice of drainage outlets, to see where their stormwater goes.

Key Learning Outcomes

SOSE	Society and Environment 3.3
	Geography 4.3, 5.2, 5.4
Science	Chemical Science 4.1
	Biological Science 5. 2

Aim

To develop students understanding of land uses and the impacts human activity can have on waterways and bays.

Materials

- Clipboard
- Pencil
- Record sheet 7: Excursion to ...
- Map of your excursion area
- Information sheets: Pollution traps (see activity 3: Stormwater pollution traps)
- Information sheets: Stormwater sources and impacts (see activity 11: Stormwater sources and impacts)

Advanced preparation

Talk to your Waterwatch Co-ordinator or Local Council Officer to determine a suitable section of nearby waterway/bay to walk along to see examples of drainage outlets and pollution traps. Obtain a map of the excursion area from them.

Duplicate the map, excursion record sheet and information sheets for small group work.

Activity

1. Students create a sketch or diagram of the street in front of their school (or home) to show how rain falling on the road and other nearby paved areas flows through the stormwater system to the local waterbody. (Hint: they will need to locate a nearby side entry pit). Where do they think their local stormwater system goes?
2. Once they have identified the waterway or beach to which their stormwater flows, arrange for the class to visit this area for field work.
3. Students walk along an appropriate section of waterway or beach. (For example, in Geelong, a good section is along the Barwon River from the Rowing Clubs to Yollinko Boardwalk, or from Rippleside to Eastern Beach.)
4. Students complete the record sheet for each site during the walk. They list the landuse and industries (e.g. parkland, shops, car repair factories, sites under construction) that exist along this section of the waterway/beach. They note the presence of native plants and animals (e.g. waterbirds). Students also note any additional observations for each site such as the look and smell of the water and air, and the type of plant growth (e.g. river banks well vegetated, or river banks mostly bare soil).
5. Once students have completed the walk, compile a class sheet which tallies all the features observed by the students.
6. Discuss the types of industry, housing and recreational activities observed.
7. Students generate a list of pollutants that could *potentially* be generated in stormwater in the area they observed if suitable precautions are not in place. They suggest what affect these particular stormwater pollutants could have on the local waterway/bay. Did they find any evidence that this type of pollution is occurring in the local waterway/bay?
8. Identify possible actions that could be taken to address stormwater pollutants generated by local industries and activities.

   This could be via small group work, individual research projects, or class discussions.
9. What are some actions that could be taken to address the pollution observed in the area? Identify who needs to take these actions, remembering that it might need several types of people (e.g. factory owners/workers, local residents, recreationists using the area, Council officers).
10. Suggest ways that these actions to reduce stormwater pollution could be encouraged.

    This could be via small group work or class discussion.

7. Record Sheet: Excursion to …

A. NOTE THE STORMWATER DRAINS YOU SEE DISCHARGING INTO YOUR WATERWAY/BAY. MARK ON YOUR MAP WHERE EACH ONE IS LOCATED.

Site	Drain No.	Where
1.		
2.		
3.		
4.		
5.		

B. NOTE WHICH STORMWATER DRAINS HAVE LITTER TRAPS/RACKS. THINK ABOUT WHEY SOME MAY NOTE HAVE ANYTHING.

Site	Litter Trap	No Litter Trap
1.		
2.		
3.		
4.		
5.		

C. NOTE THE TYPES OF LAND USE, PARKLAND OR SHOPS ALONG THIS SECTION OF THE RIVER/BAY. TICK THOSE WHICH ARE PRESENT. ASTERISK THE MAIN LAND USES AT EACH SITE.

Site	Industry	Parkland	Shops
1.			
2.			
3.			
4.			
5.			

D. EVIDENCE OF ANIMALS/PLANTS.

Site	Native	Non-Native
1.		
2.		
3.		
4.		
5.		

E. OBSERVATIONS NOTE THE COLOUR OF THE WATER, AND THE SMELL OF THE WATER AND AIR. WHAT TYPES OF PLANTS CAN YOU SEE, AND HOW WELL DO THEY COVER THE AREA? TRY TO THINK OF REASONS FOR WHAT YOU OBSERVE.

Site 1
Site 2
Site 3
Site 4
Site 5

8. A stormwater story

Summary

Students write a story, or are read a story adapted to their area, that tells a tale about stormwater pollution. At various stages in the story, students can role play or provide or observe simulations of pollutants entering the stormwater and waterway/bay.

Learning Outcomes

SOSE	Geography 4.3, 5.2
Science	Biological Science 4.1, 5.2

Aim

Students will understand links between work practices, lifestyle and stormwater pollution, and how people's everyday actions can reduce stormwater pollution.

Materials

- Information sheet 8: *Story pieces*
  (This outlines the suggested points to include, not necessarily the actually wording to be used).

Sample materials to demonstrate the pollutants used in the story include:

- coloured dye to represent polluted water
- small bits of plastic and paper to represent litter
- grass clippings
- sand
- mud
- chocolate lollies to represent dog droppings

Alternatively, the EPA poster (see activity 1) and the EPA's litter posters could be used to stimulate the students' imagination.
(see EPA's website www.epa.nsw.gov.au)

Students could also create their own story from these posters, identifying cause and effect relationships.

Activity

1. Students are read a story adapted to their area that tells a tale about stormwater pollution.

   At various stages in the story, students
   1) role play parts and/or
   2) observe demonstrations by the teacher of pollutants entering the stormwater.

2. Alternatively, students write their own story selecting from the 31 story pieces provided in the information sheet. (They do not use all 31 pieces.)

   They could write two versions, one to show a scenario with lots of pollution, and another to show a positive scenario where little pollution is occurring.

3. Students present their story to the class, using suitable demonstrations to illustrate water pollution.

8. Information Sheet: Story pieces

1. A family picnicking in a park in the town leave their rubbish behind and it washes into the gutter. It includes drink bottles, cans and paper napkins and plates.
2. A house painter washes his paintbrush with a hose into the gutter.
3. A person washes a car on a driveway.
4. A person rakes leaves from the garden into the gutter.
5. A dog is leaving its droppings on nature strip and no-one cleans up after him.
6. A woman is hosing her garden. She has just applied pesticide to the vegie patch.
7. A car is towing a trailer full of rubbish. Some is blowing out onto the road.
8. A person is eating an icecream outside the local milkbar. There is a rubbish bin nearby but he throws the wrapper onto the ground.
9. A builder has had a load of sand and gravel delivered to the nature strip in front of the house he is working at.
10. A building site has piles of rubbish left on site.
11. A school ground has lots of lolly and chip wrappers left in the grounds after lunch.
12. A sports ground has plastic ring tops from several six pack left on the ground.
13. The shopping mall has plastic bags and take-away food wrapper littering its car park.
14. A group of people throw their cigarette butts onto the footpath.
15. A person empties their car ashtray onto the ground in the car park at the local beach.
16. A car parked on the roadside is leaking oil onto the road.
17. Someone overfills their petrol tank at the service station and a small pool of petrol now lies on the concrete driveway.
18. Oil, grease, petrol and paint has spilled onto the floor of a local car repair factory. A worker hoses down the floor and sweeps the water out onto the street.
19. A family goes fishing at the river and leave their plastic bait bags and some tangled fishing line behind. They have caught five carp, a pest fish, which they leave on the river bank, feeling good that they have killed some of these fish.
20. The local Council have just spent $100,000 on installing a pollution trap at a major stormwater outlet.

21. There's a heavy rain storm. At one side entry pit, a litter trap catches some of the rubbish but other things get through. The stormwater with its collected leaves, sediment etc. flow though the barrel drain to a channelised creek. This channel flows into a larger creek. At this site a pollution trap is in place but some pollutants still get through. The trap is almost full.

22. The dog droppings and leaves that washed into the creek have decomposed in the creek, using up oxygen in the water. This causes some sensitive macro-invertebrates to die. This affects the fish that feed on these macro-invertebrates.

23. Fertiliser washes into the waterway, causing the growth of too much algae in the water.

24. The stormwater flows on to the lake/sea, which is a popular swimming and fishing spot. Visitors to the spot see the rubbish and comment on how inconsiderate it is of people to throw rubbish about on the beach/lake shore.

25. Once upon a time there used to be lots of frogs living in the creek - now you hardly ever hear them.

26. A fish with a deformity caused by pollution is caught in the lake.

27. A platypus is found dead on the shoreline, strangled by a plastic ringtop.

28. A healthy platypus is seen swimming in the local waterway.

29. The autopsy of a beached whale shows its stomach is full of plastic bags.

30. An algal bloom causes a NO SWIMMING sign to be put up.

31. A father and his two children fish at the lake in a local park. The water looks clear and he used to catch lots of fish there a few years ago. Today they have no nibbles - in fact they can't hear any frogs or see any water beetles.

32. A local Waterwatcher takes a sample of the water. In the past she had found stonefly, mayfly and caddiesfly larvae but there's none present this time. But there are some mosquito larvae and bloodworms in the current water sample.

9. Seen and unseen pollutants

Summary
Students investigate some different types of stormwater pollutants: those that are highly visible, those that are less obvious and those that are invisible.

Learning Outcomes

SOSE	Geography 4.3, 5.2
Science	Chemical Science 4.1, 4.2

Aim
Students will understand that there are different types of stormwater pollutants - easily visible pollutants such as rubbish as well as less obvious pollutants such as sediments, and the completely invisible (microscopic size) pollutants that dissolve in the water or attach to the sediments.

Materials
- Sample of coarse sediment (e.g. potting sand)
- Sample of fine sediment (e.g. silt)
- Samples of rubbish commonly found in stormwater (plastic bags, drink bottles, wrappers etc.)
- Two glasses of drinking water
- Teaspoon of salt
- Activity sheet 9

Preparation
Duplicate the activity sheet for small groups.

Activity
1. Demonstrate invisible (dissolved) pollutants as follows. Hold the two glasses of water in front of the students. Pour the teaspoon of salt into one of the glasses and stir it till it dissolves. Swap the glasses around so students don't know which is which. Ask the students if they can tell which glass is 'polluted' with salt? Can they explain what has happened to the salt?
2. Ask students to name some stormwater pollutants. As they tell you, write the pollutants down on a whiteboard/blackboard in the following three columns, without the headings (the headings will added later in the activity).

   e.g. Column 1: Easily Visible/Large pollutants
   Column 2: Less easily visible/Very small pollutants
   Column 3: Invisible pollutants
3. Ask students to suggest a heading for each column, and write these on the board.
4. Show students the sample pollutants you have collected (see Materials list) and ask them to assign each pollutant to one of the three headings decided in step 2.

   Most suggestions are likely to be Column 1.
   Silt is Column 2.
5. Which do they think might have more impact on animal and plant life in a creek or in the bay - dissolved salt or a piece of floating rubbish? Discuss reasons for this.

   Dissolved pollutants are far less obvious than rubbish but they cause more impact because they affect the living conditions for all life in the water. Rubbish is unsightly but it threatens aquatic life only if it is swallowed, wraps around or chokes them.
6. Complete the activity sheet in small groups.
7. As a class, add additional pollutant names to each of the three columns described above.

9. Activity Sheet: Seen and unseen pollutants

Type of pollutant	Examples
Highly visible pollutants • Gross pollutants	Rubbish, litter leaves and twigs larger than 5 mm
Less visible pollutants • Coarse sediment • Fine sediment	Particles between 5 and 0.5 mm Particles smaller than 0.062 mm
Invisible pollutants • Attached pollutants • Dissolved pollutants	These attach to fine sediments or dissolve in the water: - Nutrients - Heavy metals - Salts - Toxic substances (e.g. herbicides and pesticides)

Identify which type of pollutant (column 1 above) the following items are:

Pollutant	Type of pollutant	Floats/sinks/dissolves in stormwater
Chip packet wrapper	*e.g. gross pollutants*	*floats*
Plastic carry bag		
Sand from building site		
Soil from a garden		
Lawn clippings		
Cigarette butts		
Fertiliser washing off a garden/lawn/paddock		
Oil washed from road		
Lead from petrol spilt on road		
Lead washed off roof in rain		
Herbicide from garden/farm		
Pesticide from garden/farm		

Which of these pollutants undergo a physical or chemical change when they enter stormwater? Are any of the physical or chemical changes easily reversible changes?

10. Types of stormwater pollutants

Summary

Students play a match game to learn about different categories of stormwater pollutants (i.e. rubbish, sediment, nutrients, toxicants, pathogens, oxygen-depleting substances).

Key Learning Outcomes

SOSE	Geography 4.3, 5.2
Science	Biological Science 4.1, 5.2

Aim

Students will become familiar with different types of pollutants.

Materials

- Information sheet 10: Categories of pollutants
- Samples or photographs of stormwater pollutants listed in the information sheet

Advanced preparation

Collect samples as per Materials list. Photocopy the information sheet for small group work.

Write up a set of cards for each small group: one card for each heading listed in the information sheet (i.e. rubbish, sediment, nutrients, toxicants, pathogens, oxygen-depleting substances).

Activity

1. Handout the information sheet and check that students understand the terms.
2. Distribute pollutant samples and heading cards to each small group.
3. Working in small groups, students match the stormwater pollutant examples to the correct heading card, e.g. they match the paper and plastic to the Rubbish heading.
4. Discuss as a class to check all groups have the correct matches.
5. You could set this matching game up as a race against the clock to see which group finishes first.

Extension

Continue this investigation with Activity 11: Stormwater sources and impacts.

10. Information Sheet: Categories of pollutants

Pollutant	Examples
Rubbish	Paper, plastic bags, bottles, cans, cartons etc.
Sediment	Silt, sand, gravel, clay
Nutrients	Phosphorus, nitrogen
Toxicants	Pesticides, herbicides, petroleum products (e.g. petrol, oil), lead, zinc
Pathogens	Bacteria, viruses, faecal coliforms (*E. coli*)
Oxygen-depleting substances	Organic matter, leaves, dead vegetation

11. Stormwater sources and impacts

Summary

Students create and play a quiz card game to test their knowledge of stormwater pollutants and where they come from. This activity is a continuation of activity 10: Types of stormwater pollutants.

Key Learning Outcomes

SOSE	Geography 4.3, 5.2
Science	Biological Science 4.1, 5.2

Aim

Students will understand where different types of pollutants can come from and what impacts they can have on waterways and bays.

Materials

- Information sheet 11: Pollutants sources and impacts
- Samples (real items, photographs or drawings) of the stormwater pollutants listed in column 1 of the information sheet: Stormwater threats and impacts
- Pin boards
- Pins
- Cards

Advanced preparation

Photocopy the information sheet for small groups.

Activity

1. Working in small groups, students read the information sheet on stormwater threats and impacts to find out typical sources for the different types of pollutants. Discuss these impacts and sources to check that all students understand the terms.
2. Each group prepares a pin board with the three headings: Pollutant, Impacts, Sources across the top and the list of pollutants down the side (column 1)
3. They write up cards based on the information in the column 'Impacts on waterways/bays' - one card for each dot point. On the reverse side of each card they write the word 'IMPACT'.
4. Next, they write up another set of cards based on the information in the column 'Typical sources of this pollutant' - one card only for each pollutant. On the reverse side of each of these cards they write the word 'SOURCES'.
5. Working in small groups they play the quiz game to match each pollutant with its correct Impact or Source. Each student chooses either an Impact or Source card from the piles and matches it to the correct heading and pollutant.
6. The game can be played to see which team most quickly completes all the matches correctly.

11. Information Sheet: Pollutant sources and impacts

Pollutant	Impacts on waterways/bays	Typical source of ths pollutant
Rubbish / litter	• Mainly visual. • Interferes with aquatic life.	Fast food outlets, commercial areas, residential areas.
Sediment	• Muddy water. • Siltation. • Smothering of aquatic life.	Construction sites, unmade roads, industrial areas, eroding streambanks.
Nutrients	• Promotes excessive plant and algal growth. • Blue-green algal blooms (eutrophication). • Waterway closed to swimming/fishing during algal bloom.	Animal droppings, sewer overflows, sewage treatment plant discharges.
Toxicants	• Kills aquatic life, especially animals high up the food chain.	Cars, car parks, roads, industrial areas, chemical spills, atmospheric deposits.
Pathogens	• Closure of beaches. • Human illness.	Animal droppings, sewer overflows.
Oxygen-depleting substances	• Low oxygen levels in water. • Stress on aquatic life. • Smells.	Animal droppings, grass and leaf litter, sewer overflows.
Altered flow	• Increased water volumes or speed can erode waterways and bays. • Increased amounts of freshwater entering bays can affect marine habitats.	Increased stormwater run-off, for example from new drainage outlets and new urban developments.

ADAPTED FROM: URBAN STORMWATER: BEST PRACTICE ENVIRONMENTAL MANAGEMENT GUIDELINES (MELBOURNE WATER CORPORATION, 1999). CSIRO PUBLISHING.

12. Run-off surfaces

Summary

Students construct different surfaces to observe differences in run-off and absorption levels.

Key Learning Outcomes

SOSE	Geography 5.2
Science	Earth and space sciences 3.1
	Chemical Science 4.1
	Earth Science 5.2

Aim

To develop students understanding of permeable and impervious surfaces and the impact human change to surfaces can have on environments.

Materials

- Plastic bottles (1.25L or 2L soft drink bottles are ideal)
- Stanley knife (use with adult supervision)
- Soil
- Grass/plants such as mondo grass
- Mulch material
- Stones
- Measuring jug
- Water
- Activity sheet 12a: Run-off records
- Activity sheet 12b: Run-off comparisons

NB: Mondo grass, a low growing grass-like plant, is readily available from nurseries.

Advanced preparation

Collect bottles, grass/plants, soil, mulch, water, stones.

Photocopy the Run-off record sheet.

Activity

1. Prepare three plastic bottles by cutting the base off each, as shown in the diagram on the next page.
2. Use the top half of each to create three different 'surfaces' to test. Fill one bottle with soil. Plant out with mondo grass or similar. Cover any bare soil with at least 10mm of mulch material.
3. Fill another bottle with soil mixed with a few stones. Cover this with a thin layer of mulch material (5mm).
4. Fill a third bottle with stones with very little soil.

   Teacher could prepare these three samples for younger students.
5. Sit each simulated 'surface' into the bottom half of a cut bottle (as shown).
6. Using a measuring jug, pour 250ml of water onto each 'surface'.
7. Time how long it takes for the water to percolate through each 'surface'. Students record the results on activity sheet 12a. Which took the longest?
8. In small groups students complete the questions of activity sheets 12a. Discuss the results and questions as a class.
9. Students complete activity sheet 12b.

Background

Different types of surfaces have different abilities to absorb rain into the ground.

Permeable surfaces are those which easily allow water to seep through them. For example: grass covered soil, bushland.

Impervious surfaces are those which do not allow water to seep through them, or only very very slowly, so most water runs off them.

For example: concrete, bitumen.

When people change the land, they often cover natural permeable surfaces with impervious surfaces. This increases the rate and amount of run-off.

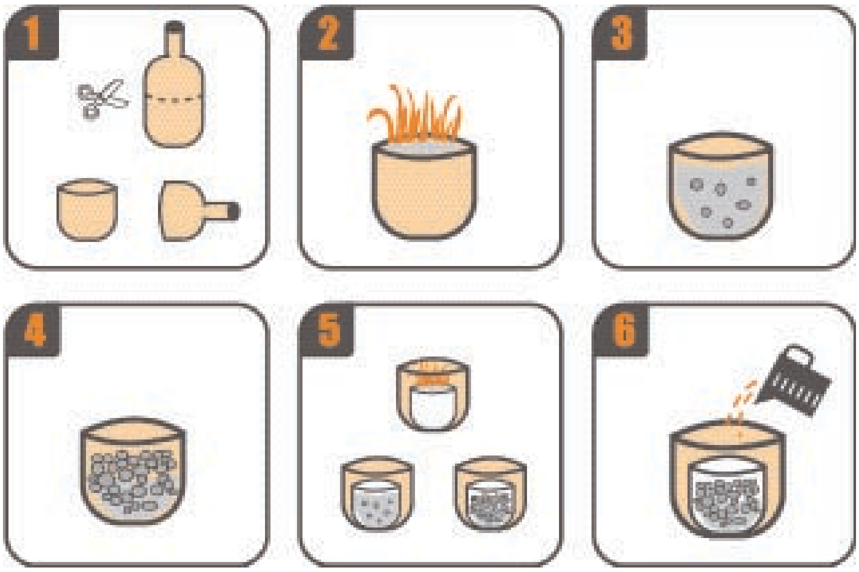
Prior to European settlement, many areas of Australia were vegetated so water easily seeped into the soil. The plants also slowed the movement of water across the land surface.

In areas where cities were built, the land was covered with buildings, concrete and bitumen. Water flows over these artificial surfaces at a much faster rate than over vegetated surfaces and much less water is able to be absorbed into the soil.

Stormwater in urban areas collects pollutants from these concrete and bitumen surfaces and eventually carries them into rivers and the sea. Faster flowing water carries more pollutants than slower flowing run-off because the pollutants have not been able to settle out and be absorbed into the soil.

The increased run-off means that:

- Run-off travels much faster and picks up more pollutants.
- Urban waterways flood more quickly.
- Urban waterways erode more quickly now because they carry faster flowing water.



12a. Activity Sheet: Run-off records

	Bottle 1	Bottle 2	Bottle 3
	Soil & Grass	Soil & Stones	Stones
Time taken			
Volume of run-off			

1. Which surface provided the least run-off (most absorption)?

2. Which surface had the most run-off (least absorption)?

3. Use your results to list the types of surfaces commonly used in urban areas that you think would create the most run-off into stormwater drains.

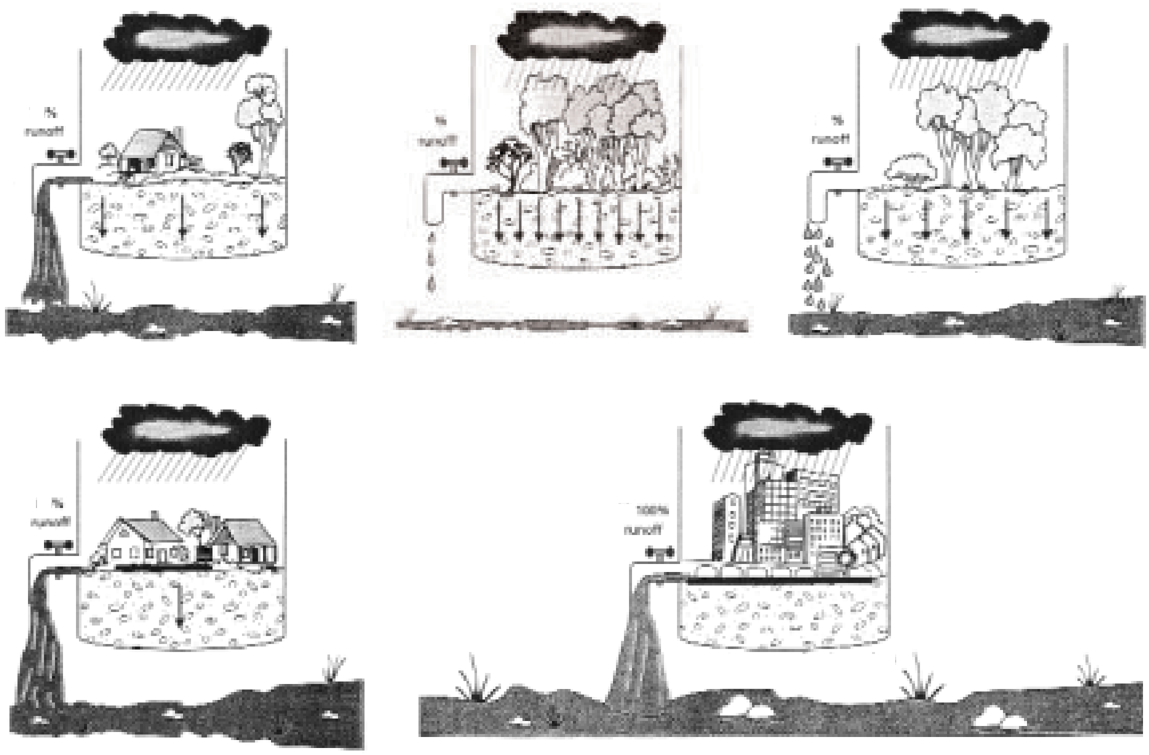
4. When might these surfaces cause problem for stormwater drainage?

5. Suggest a possible solution to this drainage problem.

12b. Activity Sheet: Run-off comparisons

7. Place the following illustrations in the correct sequence to show most run-off to least run-off. Add the following captions to the correct diagram and add the % run-off.

Good ground cover	98 % infiltration, 2% runoff
Fair ground cover	76 % infiltration, 24% runoff
Poor ground cover	27 % infiltration, 73% runoff
Mostly impervious surfaces	15 % infiltration, 85% runoff
Concrete and bitumen impervious surfaces	0 - 2 % infiltration, 98 -100% runoff



REPRODUCED WITH PERMISSION FROM: BACKYARD TO BAY CATCHMENT IMPACTS: THE URBAN WATERWAY CHALLENGE. MELBOURNE WATER AND MELBOURNE PARKS AND WATERWAYS, 1993.

13. School stormwater catchment map

Summary

Students construct a map of their school's stormwater catchment.
Students should have been on a local catchment walk and noted the location of side entry pits, etc. (See activity 7: Where does your stormwater go?)

Key Learning Outcomes

SOSE	Society and Environment 3.2
	Geography 4.1, 5.1, 5.2

Aims

Students understand the concept of a catchment and how the stormwater from their school drains into a local waterway/bay.

Materials

- Drainage plan for the area which includes your school (contact the local Council)
- Coloured pencils

Advanced preparation

Make copies of the local drainage map for small group work.

Students will need to know how to use maps, i.e. legends, north indicator, scale drawing.

Activity

1. Working in small groups, students examine the stormwater catchment map and mark where the school is placed within the catchment. Using coloured pencils and symbols they create a legend and mark up the map to show:
    - your school
    - parks/gardens
    - shopping strips/shopping malls
    - factories/industrial areas
    - side entry pits
    - stormwater pollution traps

    The map should also include features such as a north indicator and a title.

2. Students mark in which streets and parks have:
    - deciduous trees (brown)
    - native trees (green)
    - concrete guttering

3. On the map students highlight the path of water from the school to the main drainage point and on beyond the school to a local waterway. Remember that stormwater cannot flow up hill!

Extension

To further develop their mapping skills, students redraw the drainage map to a different scale.

14. Surfaces in the school ground

Summary

Students conduct an experiment to determine which surfaces in the school ground are absorbent and which create the most run-off into the stormwater system.

Key Learning Outcomes

Science	Chemical Science 4.1
SOSE	Geography 5.2

Aim

Students identify permeable and non-permeable surfaces in the school ground and understand the effects different surfaces have on stormwater run-off.

Advanced preparation

Students should have completed activity 13: School stormwater catchment map.

Arrange students into small groups for the experiment. Check that students understand the terms: pervious, semi-pervious and impervious.

Materials

Per group:

- School map
- Coloured pencils
- Drink bottle
- Measuring jug
- Stop watch or watch with seconds hand
- Record sheet 14: Surfaces in the school grounds

Activity

1. Students list surfaces types in the school ground (e.g. concrete, grass, mulched, bitumen).
2. Each group chooses four different surfaces to test: to determine how much water flows off or is absorbed by each type of surface.

   To reduce the time taken for this activity, each group could study two surfaces and compare results as a class. Students can then discuss testing procedures and the need for consistency in testing methodology.
3. Working in small groups, at each site they pour 100ml of water onto the surface. Students complete the record sheet for each site. They time how long it takes to sink in or run off. Each group repeats the water pouring experiment three times at each site. They then work out the average time taken for each type of surface. Factors such as vegetation and slope should also be noted on the record sheet.
4. As a class, compile the class results. Why use average times rather than one reading?
5. On their school map, students colour in all the surfaces that are pervious. In a different colour they mark in all the areas that are semi-pervious. Using a third colour they mark in areas that are impervious. They add these colours to their map's legend.
6. As a class, discuss which surfaces in the school ground create the most run-off?

14. Record Sheet: Surfaces in the school ground

	Description of site	Sinks in quickly	Sinks in slowly	Runs off	Comments
Site 1 1 2 3 Average					
Site 1 1 2 3 Average					
Site 1 1 2 3 Average					
Site 1 1 2 3 Average					
Site 1 1 2 3 Average					

15. Litter mapping your school

Summary

Students make a map of the school grounds, highlighting the litter collection points and stormwater routes.

Key Learning Outcomes

SOSE	Society and Environment 3.2
	Geography 4.3, 5.3

Aim

Students understand how pollutants from their school ground can get into local waterways.

Materials

- Existing map of the school (Most schools have a displan map or emergency plan map)
- Coloured pencils

Activity

1. On the existing map of your school, identify the different buildings, play and garden areas so that students know how to read and use the map.
2. The following mapping activity is best done after lunch. Walk around the school grounds as a class, taking note of where the rubbish bins are located and where litter has accumulated on the ground over the day. Mark the bins and litter areas on the map.
3. Mark on the map the stormwater and wastewater drains and pipes located in your school. Make sure the students are clear which pipes drain into the wastewater system and which drain into stormwater. Mark these pipes on the map.

   Wastewater pipes in the school ground are only likely to be those that are connected to the drinking taps or similar. Stormwater pipes will be the down pipes leading from the roof or guttering of any building.
4. Ask students to suggest how the litter lying on the school grounds might get into the local waterway or bay?

   Rain could wash it into the stormwater drain that flows into the creek/bay. The wind could blow it to another location before it gets washed into the stormwater system.
5. Ask students to suggest ways of reducing or preventing litter in the school ground.

   E.g. Using less throw-away packaging with their snacks/lunches so that less rubbish is created in the school.

   Making sure rubbish gets put into bins, that the rubbish cannot blow out of the bins, and that animals cannot get into the bins and spread the rubbish.

16. Rubbish diary

Summary

Each student keeps a diary for one week to see how much rubbish they produce while at school.

Key Learning Outcomes

SOSE Geography 4.3, 5.2

Aim

Students understand the types and amount of litter they generate.

Materials

- Notebook and record sheet
- Two large bins in class to sort and collect students' rubbish

Activity

Is much rubbish left in the school's playground?

1. Students keep a diary for one week to record every piece of rubbish they create. This includes lunch and snack wrappings, fruit peel, food scraps and drink containers, plus items such as paper, plastic bags and pencil sharpenings.

   Students should not keep the rubbish - just record the types and the amount.

2. Each day during the week, students place their rubbish into bins located in class (or a designated area). Discuss organic and inorganic materials and the typical materials that fit in each category. Ask students to divide their rubbish into organic and inorganic. One bin collects their organic rubbish while the other bin collects their inorganic rubbish.
3. To accurately establish how much rubbish is being produced, weigh the rubbish at the end of every lunch hour.
4. Using the students' diary records, tally the amount of each rubbish type generated by students and collate a class total.
5. Based on the results from steps 3 and 4, students calculate how much rubbish the class produced during the week. How much was organic? How much was inorganic? Estimate how much rubbish the whole school would produce in a week? In a year?
6. Students calculate how much of the school's rubbish could potentially end up in the local waterway/bay if, say, one-tenth of the rubbish created in the school over a year was left in the playground.
7. Students could take action to reduce the amount of rubbish they produce by having a "rubbish free lunch". This can be done as a class or as a school.

Extension

- Check litter activities in the Waste Wise Schools program on www.gould.edu.au
- Your local Council may have a Waste Education Officer who can provide ideas for reducing rubbish.
- The Department of Education offers prizes for its Rubbish Free Lunch Challenge, and provides activity ideas on its website.

17. Street sweeper

Summary

Students collect and assess the types and amount of litter generated by their neighbourhood. This activity could be adapted to conduct within the school grounds if safety is an issue.

Key Learning Outcomes

SOSE	Society and Environment 3.2
SOSE	Geography 4.3, 5.2
Science	Chemical Science 4.2
	Biological Science 5.2

Aim

Students become aware of the different types and amounts of pollutants found on urban streets and their impact on waterways.

Materials

- Activity sheet 17: Street sweeper
- Used plastic shopping bags (all the same size)
- Tape measure
- Witches hats
- Brooms
- Small spades
- Dustpans
- Bathroom/kitchen scales
- Gloves for all participants
- Tongs for all participants
- Container for storing sharp material (e.g. broken glass, syringes)

Advanced preparation

Duplicate the activity sheet.

Safety note: During this activity only adults should pick up sharp materials.

Activity

1. Select a roadway near your school that does not receive much traffic (so it is safe for this activity). Measure out a section of this roadway (fifty metres is easy to multiply later). Place witches hats to mark this section.
2. The teacher or a parent must carefully survey this area first and, wearing gloves and using tongs, collect any sharp material.
3. Working in small groups and wearing gloves, students sweep designated sections of the marked section of the street, collecting everything from the nature strip, gutters, footpaths and roads.
4. Wearing gloves and using tongs, each group carefully divides the collect material into three categories: a) organic material, i.e. leaves, twigs, dog droppings, b) rubbish and c) sediment i.e. sand, silt, clay.
5. Place this material into shopping bags, one for each category. Weigh each category.
6. Identify if and how each of these materials will change when it gets into the stormwater.
7. Student complete activity sheet 17 to calculate the number of bags full per kilometre that could end up in the local waterway/bay.
8. What impacts could these materials have on the local waterway/bay?

17. Activity Sheet: Street sweeper

1. How many bags did you collect?

Organic __________________

Rubbish __________________

Sediment __________________

Total bags __________________

2. How much did they weigh?

Organic __________________

Rubbish __________________

Sediment __________________

Total : __________________ kilograms.

Using the formulas below, calculate:

3. Percentage of organic material:

Number of bags of organic waste (   ) x 100 = ...%

Total number of bags (   )

4. Percentage of rubbish:

Number of bags of rubbish (   ) x 100 = ...%

Total number of bags (   )

5. Percentage of sediment:

Number of bags of sediment (   ) x 100 = ...%

Total number of bags (   )

6. How much material does one kilometre of street potentially add to your local waterway/bay?

One kilometre has 20 lots of 50 metre sections of road. A street has gutters on both sides (x 2). Therefore:

Total bags .... x 20 x 2 = ...bags full per one kilometre section of road.

7. Try to work out the percentage in weight of each category

Hint: Organic kg (   ) x 100 = ...% weight

Total kg (   )

Extension:

Select a different stretch of roadway or another part of the school to repeat the activity and compare the results.

18. Survey - What do you know?

Summary

Students develop and conduct a survey to establish what people know about stormwater.

Key Learning Outcomes

SOSE Geography 4.3, 5.3

Aim

For example:
To investigate what people know about stormwater issues.
To investigate if people's attitudes about stormwater have changed over time.

Activity

1. As a class, or working in small groups or individually, students decide what they want to find out about stormwater and water quality from their survey.
2. Once they are clear about what they want the survey to answer, students create a series of suitable questions to ask grandparents, parents, neighbours, and/or students in other classes to obtain this information. They could be questions that investigate past and/or present use of a local river/bay and people's perception of whether these uses impact on the waterway/bay. Questions could also be about general knowledge of stormwater drainage system and its link to waterways, and/or of things that pollute waterways.
3. After the surveys have been completed by the target audience, students collate the findings in small groups. What do the findings suggest? Were their questions clearly worded? Could the questions have been improved or additional questions asked?

   Have uses of the local waterways changed much over time? Do most people understand the present stormwater system? Do younger people have a better understanding of current stormwater drainage systems and issues than older people?

Background

In the past, stormwater management practices focussed on drainage and flood protection for the human population. Solutions were often 'engineered' solutions such as channelising (straightening and concreting) waterways to reduce flooding threats. The practical implications of these construction changes on the ecological and environmental processes were often overlooked.

Factories were allowed to discharge their wastewater untreated into waterways/bays.

Today, waterways are not just seen in terms of flood control or as discharge outlets. Factories are now required by the EPA to discharge wastewater into the sewerage system (where it can be treated). More people now value the recreational and ecological uses of waterways. Many people are beginning to better understand the environmental impacts of polluted stormwater.

19. What's their value?

Summary

Students assign values to a local waterway/bay.

Key Learning Outcomes

SOSE	Economics 4.2
	Geography 4.3, 5.3, 5.4

Aim

Students understand that waterways and bays have many different values.

Materials

- Information sheet 19: What's their value?

Advanced preparation

Duplicate the information sheet for small group work.

Activity

1. Discuss with the class the following terms and categories of values for local waterways/bays.
    - Environment
    - Amenity
    - Economic
    - Hydraulic
    - Cultural

    Refer to the description in column 1 of the table in the information sheet.

2. Brainstorm with the class a list of possible values for local waterways/bays.
3. Working in small groups, students conduct research, either via printed materials and maps, or by interviewing a range of people, to gather information about what people value about a local waterway/bay.
4. After conducting their research, each group uses the information sheet to assign values to a local waterway/bay (or section of waterway/bay).
5. Each group presents their findings to the class.
6. Compare results as a class and discuss the following:
    - Do values vary for different stretches of waterway or at different locations?
    - Which values are compatible?
    - Which values are not so compatible?
    - What do these different values suggest for the management of stormwater flowing into a local waterway/bay?

19. Information Sheet: What's their value

Waterways and bays:

- Perform important drainage and flood protection functions
- Provide attractive recreational areas for people
- Are home to many plant and animal species
- Often contain areas of significance to the community
- Can enhance property values

Value	Examples
Environment The physical and ecological values of waterways	• Biodiversity • Significant species (e.g. rare or threatened) sites of significance • Listed sites (e.g. Ramsar internationally important wetland sites)
Amenity Recreational and landscape values	• Public access • Open space • Facilities such as trails, car parks, picnic areas
Economic Economic benefits gained from water environments	• Water use • Fishing • Aquaculture • Tourism
Hydraulic Contributions to the protection of property and public safety from the risk of flooding	• The extent to which the environment contributes to the protection of property and public safety from flooding
Cultural Known sites of cultural and heritage significance	• Sites of cultural and heritage significance

Adapted from: *Urban Stormwater: Best Practice Environmental Management Guidelines* (Melbourne Water Corporation, 1999). CSIRO PUBLISHING.

20. Who's responsible?

Summary

Students investigate who is involved in stormwater management.

Key Learning Outcomes

SOSE	Economics 4.2
	Geography 5.4

Aim

Students understand that local and State agencies and urban developers are involved in stormwater management and that a partnership approach is needed to effectively deal with stormwater management.

Materials

- Information sheet 20: Who's responsible?

Advanced preparation

Duplicate the information sheet for small group work.

Activity

1. Assign each small group an agency/group from the following list:
   - Your local government (Council)
   - Urban developers
   - Environment Protection Authority
   - Melbourne Water Corporation
   - Your local Catchment Management Authority
   - Your local Water Authority
   - Department of Natural Resources and Environment
   - Vic Roads
2. Working in small groups, students read the relevant section of the information sheet to gain some background about their assigned agency's/group's role in stormwater management.
3. Each group uses the internet to further investigate their assigned agency's/group's role in stormwater management.
4. Each group gives a short presentation to the whole class about their assigned agency/group's connections with stormwater and their current or potential role in stormwater management in your town/city/area.

20. Information Sheet: Who's responsible?

Those responsible for the environmental management of urban stormwater include State government agencies, local government, and urban developers.

Local Government

Local government, with its responsibility for land use planning, land and stormwater management has a major ability to affect stormwater quality. Local government is responsible for managing the various parts of the urban environment that drain directly into the stormwater system. These include roads, reserves, parks and car parks. Local government authorities can help protect stormwater quality by reducing the amount of impervious surfaces, by providing enough space for stormwater detention and treatment, and by including appropriate drainage infrastructure.

Many Councils have recently prepared Stormwater Management Plans (SMPs), or are currently in the process of preparing one.

Stormwater Management Plans provide a framework for including stormwater management within Council's existing management and planning activities. A SMP provides an on-going process for protecting and enhancing the environmental values and beneficial uses of waterways, lakes and beaches/bays/estuaries that are currently threatened by stormwater run-off.

Urban developers

Urban developers (both private companies and government agencies) affect stormwater quality during the construction period of development and as a result of increased areas of impervious surfaces created by development. Soil is often removed and left exposed to erode into waterways. Construction activities need to be undertaken in a way that stops sediment from flowing off the site into waterways, and for contaminated run-off to be contained.

Water sensitive urban design (WSUD) offers an alternative to the traditional approach of collecting, concentrating and disposing of stormwater downstream. WSUD more closely matches the natural water balance by:

- Slowing down the run-off
- Allowing more of the run-off to seep into the ground
- Using wetland and other treatments to remove pollutants.

For more information about WSUD
www.melbournewater.com.au

State Government agencies

ENVIRONMENT PROTECTION AUTHORITY (EPA)

The EPA is responsible for the protection of the quality of Victoria's environment under the powers described in the 1970 Environment Protection Act of Parliament. The role of the EPA in stormwater management includes:

- Establishing environmental standards for waterways and bays through State environmental protection policies (SEPPs)

Refer to EPA website for more information.
www.epa.vic.gov.au

MELBOURNE WATER CORPORATION

Melbourne Water is responsible for managing all the major drains and waterways in the Melbourne metropolitan area, generally in catchments larger than 60 hectares in area (smaller ones are management by local government).

In Melbourne there are around 1100 kilometres of constructed drains and 5000 kilometres of waterways.

Melbourne Water's role in stormwater management includes:

- Providing overall direction and strategies for stormwater management in Melbourne
- Setting standards for planning and design of drainage infrastructure to reduce the risk of flooding and protect waterways and bays from the impacts of urban development
- Working with local government and developers to plan new drainage infrastructure in developing urban areas
- Responsibility for the maintenance of the constructed drainage system

Refer to Melbourne Water's website for more information.
www.melbournewater.com.au

CATCHMENT MANAGEMENT AUTHORITIES (CMAS)

Catchment Management Authorities have been established in rural Victoria within the nine Catchment and Land Protection Regions of Victoria. Their role is to ensure the sustainable development of natural resource-based industries, the protection of land and water resources, and the conservation of natural and cultural heritage.

CMAs provide services relating to waterway and floodplain management. These focus on the maintenance and improvement of river health and the minimisation of costs of flooding, while preserving the natural functions of the flood plain. CMA services include:

- Waterway management
- Water quality management
- Management of flood plains
- Management of rural drainage
- Management of Crown land frontages
- Management of Heritage Rivers outside National Parks

Refer to CMA's general website for more information, and use the link to your local CMA. www.nre.vic.gov.au

DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENT (NRE)

NRE is responsible for the integrated management of Victoria's natural resources. Their objectives include achieving healthy rivers and catchment though a partnership approach with other agencies.

NRE oversees the development and implementation of water quality and nutrient management plans and leads a range of water quality management initiatives.

Refer to NRE's website for more information.
www.nre.vic.gov.au

Others

Vic Roads plays a role in stormwater management by taking measures to reduce the impacts of run-off from its roads.

21. Stormwater management plans

Summary

A Council Officer talks to students about the Stormwater Management Plan prepared/being prepared for their municipality.

CSFLearning Outcomes

SOSE	Economics 4.2
	Geography 5.4

Aim

Students will understand that a range of actions are needed to manage stormwater and reduce pollution impacts on waterways/bays. They will appreciate the role of a Stormwater Management Plan in achieving this.

Materials

- Information sheet 21: Stormwater management plans

Advanced preparation

Contact your local Council's Environment or Waste Education Officer and ask if they can give a short talk to your students about the local Stormwater Management Plan. If a Council officer is not available, your Waterwatch Co-ordinator may be able to assist.

Provide the speaker with a copy of the information sheet: Stormwater management plans. Ask if he/she can structure their talk to include examples of as many as possible of the management actions listed on the left hand side of the information sheet.

Photocopy the information sheet for small group work.

Activity

1. Prior to the arrival of the speaker, distribute the information sheet to small groups to read and prepare questions for the speaker.
2. Students listen to the presentation on the local Stormwater Management Plan.
3. Students ask questions of the speaker about local stormwater management actions that are/can be taken.

21. Information Sheet: Stormwater management plans

A Stormwater Management Plan helps Council and other catchment managers:

- recognise threats to the local environment caused by urban stormwater
- identify actions to reduce urban stormwater problems
- develop good management strategies and program to protect local waterway environments.

A Stormwater Management Plan might identify actions for:

Planning controls	These help reduce the potential impacts of land development and the impacts of land use on water quality.
Operations and land management	Setting up good procedures for waste collection so that stormwater is protected.
Education and awareness	Running programs for schools, the community and businesses to help people understand stormwater impacts and what they can do to reduce stormwater impacts.
Infrastructure	Identifying structural features such as pollution traps to capture and retain some pollutants.

Possible actions:

Land use planning	• Development plans • Planning permits
Urban design	• Subdivision layout • Open space planning • Road system layout • Streetscape layout and design • Drainage design
Land management	• Municipal operations - waste/litter collection • Construction - Local Laws/building controls • Business operations
Education and awareness	• Media articles • Pamphlets and brochures • Education manuals, programs and activities • Workshops and demonstration projects
Stormwater treatment	• Artificial wetlands, pollution traps • Flow management such as channel design, storage and run-off control • Sediment basins

22. Prevention is best: What can I do?

Summary

Students identify actions they can take to reduce stormwater pollution.

Key Learning Outcomes

SOSE Geography 4.3, 5.4

Aim

Students become motivated to undertake a range of everyday actions to help reduce stormwater pollution.

Materials

- Information sheet 22: What can I do?

Advanced preparation

Duplicate the information sheet for small group work.

Activity

1. Brainstorm with the class ideas for reducing stormwater pollution. Which ones are actions for preventing the pollution from occurring in the first place? Which ones are actions for cleaning up the pollution once it has occurred? Discuss the advantages of preventing the pollution from occurring in the first place.

   Advantages include: reduce amount of money needing to be spent on pollution clean up; cleaner, more enjoyable environment for people and wildlife, fewer days of beach closure for swimming/fishing.

2. Distribute the information sheet and discuss with the class any additional ideas listed in the table.
3. Ask students to explain the reasons behind each DO and DON'T in the information sheet.

PERSONAL ACTION

4. Students identify actions that they will personally undertake for the next month, and write a 'pledge' stating what actions they will take. They ask their parent/guardian to sign their pledge.
5. After a month, each student reports back honestly on how well they have kept their pledge. Which actions have they been able to fulfill? Which actions if any have they not always been able to fulfill? What would help them undertake this action in future?
6. Celebrate the successes students have had in reducing litter/stormwater pollution in your school/neighbourhood/town.
   e.g. awards, article in school newspaper

COMMUNITY ACTION

7. As a class, decide which actions you want to take to raise community understanding about stormwater pollution.

Ideas include:

- Take part in drain stencilling and prepare a leaflet for local residents about the drain stencil, what it means and what they can do to help reduce stormwater pollution on their nature strip/in the streets.
- Take part in water quality monitoring via your Waterwatch Co-ordinator to monitor your local waterway and address any stormwater pollution that may be occurring.
- Design posters for targeted segments of the community (e.g. residents, shop owners, builders, people walking their dogs).
- Prepare articles for the local paper/your school newsletter.
- Prepare a fact sheet or brochure for targeted segments of the community.
- Prepare a public service community announcement for radio or TV.
- Design signs for a local park or a litter hot spot to convey a stormwater or litter prevention message.
- Design and prepare a display for the school or for a local show.
- Prepare a short play to tell a story about stormwater pollution and how it can be prevented. Design costumes for the 'players'.
- Take part in a local community clean-up day.
- Visit a litter hot spot and identify the major types of rubbish. Taking note of the kind of rubbish items at the site, devise an advertisement to inform and motivate people not to litter.
- Prepare a friendly letter for local food outlets that appear to be generating litter. Encourage the shop keeper to use less packaging or recyclable packaging and provide suitable bins for collecting the rubbish or recyclable containers created by their products.

22. Information Sheet: What can I do?

	Do	Don't
Water conservation	Sweep rather than hose paths	Don't hose paths
	Wash your car on grass, or use a car wash that recycles water.	Don't wash your car on concrete/bitumen.
	Install a rain water tank.	
	Fix leaking garden taps.	
Drainage	Collect and re-use drainage water on site.	Don't fill in or alter natural drainage lines.
Litter	Put all rubbish into bins or take in home and bin it.	Don't throw rubbish onto the street/school yard/sports ground
	Buy drinks and snacks in bulk so you can repackage them into re-useable containers for lunches and snacks at school.	Don't buy food/drink with non-recyclable packaging, or lots of packaging.
	Pick up litter, especially plastic bags and wraps that can be a danger to aquatic life.	Don't litter the streets/school yard.
	Put cigarette butts into bins.	Don't throw cigarette butts onto paths or streets.
	Empty rubbish bins before they overflow.	Don't dump rubbish.
	Make sure your rubbish and recycling bins have lids so items can't blow away	
	Make sure the newspaper/ paper/ cardboard you put out for recycling it securely tied or weighted so it can't blow away.	
	Report litters/polluters to authorities (EPA)	
Erosion	Place sediment control barriers (e.g. hay bales) around construction sites.	Don't leave large areas of exposed soil.
	Minimise disturbance to the surface of the soil.	Don't create steep embankments.

	Do	Don't
Pets	Pick up dog and animal droppings and put them in a bin.	Don't sweep droppings/manure onto the road or into drains.
Pollution	Quickly mop up chemical spills.	Don't pour chemicals, oils or other pollutants down the drain or on the ground.
Around the garden	Minimise the use of herbicides and pesticides around the garden.	Don't dump soil, sand, bark or compost deliveries over gutters.
	Stop soil, sand, bark or compost deliveries from being carried with run-off into gutters.	Don't drain swimming pools directly into stormwater drains.
	Sweep up leaves and rake up grass clipping and put them back on the garden or into the compost.	Don't sweep leaves, grass clippings or twigs into the gutter.
	Mulch the garden beds so as to conserve water.	Don't use herbicides or pesticides near waterways.
On construction sites	Control litter and erosion.	Don't dump litter, soil, sand etc. directly onto the nature strip.
	Remove excess mud from vehicles before leaving the construction site.	Don't wash mud off equipment in the street - it flows down a stormwater drain.
		Don't wash paint brushes or rinse paint containers in the street.
On the farm	Collect and re-use irrigation water and stormwater run-off.	Don't pour chemicals down the drain or into the creek.
	Create barriers to prevent seepage from manure stockpiles.	
	Minimise the use of fertilisers, herbicides and pesticides near waterways.	

(ADAPTED FROM CASEY STORMWATER MANAGEMENT PLAN. CITY OF CASEY. JUNE 2000)