5. Water conservation, recycling & reuse

Background Information

Water is an extremely precious resource. Of all the water in the world, 97% is salt water and only 3% is fresh water. Of this 3%, a tiny amount (less 0.01%) is available for human use. The rest is frozen in glaciers or polar ice caps, or is deep within the earth, beyond our reach. To put it another way, if 100 litres represents the world's water, about half a tablespoon of it is fresh water available for our use.

At the Coal Loader Centre for Sustainability there is a strong emphasis on water conservation, recycling and reuse. A 50,000 litre underground water tank (pictured) captures rainwater from the roofs of surrounding buildings. The water is used for toilet flushing, garden and nursery irrigation and general washing-down. If the tank is full it overflows into the adjacent wetland. This thriving wetland now occupies the former site of one of two Union Steam Shipping Company fuel tanks.

Other water saving measures at the Coal Loader include the use of water saving devices such as tap aerators, dual flush toilets and water saving appliances eg dishwasher. The bathroom includes 4 star WELS rated toilets which use only 3.5L water per flush compared with 12L for a traditional toilet, and 6 star WELS rated taps, using only 4.5L water per minute compared to a normal tap using up to 18L per minute.

By visiting the Coal Loader site you will also be able to see the wetland developed in the 1990s on the sandstone bedrock as part of site remediation works, by the site caretaker. The wetland is fed by stormwater runoff from adjacent buildings and is home to wildlife including fish, turtles, ducks and a vocal colony of frogs.

In the past, wetlands were often thought of as

wastelands. They were often drained, filled and used for parks, playing fields and housing developments. This meant that stormwater was no longer filtered through the wetlands but instead piped directly to our local waterways through a system of man-made concrete drains. This is why our waterways became polluted.

In urban areas today, one of the primary functions of wetlands is to improve the stormwater quality that enters our oceans. Wetlands remove pollutants from our stormwater such as nutrients and suspended solids such as soil. By doing so, it assists the health of our coastal waterways.

Curriculum links:

- ✓ Stage 3 Mathematics and Science
- ✓ Stage 4 Mathematics and Science
- ✓ Stage 5 Science

See the Curriculum Matrix (Appendix 1) for more detail.

Further Information

- Save Water *www.savewater.com.au*
- Wetland Australia *www.wetlandcare.com.au*
- Sydney Water *www.sydneywater.com.au*
- Streamwatch *www.streamwatch.org.au/cms/resources/manual_pdfs/BugGuide.pdf*

Watch the three minute video! The Water Conservation, Recycling & Reuse video will give your class an overview of what you can expect to see and learn about water conservation, recycling and reuse at the Coal Loader.

North Sydney Council thanks Sydney Water for providing advice and information on this chapter.

Activity 1 – Spot the Water Wise Design Features

Activity Summary:

This activity requires students to locate water saving technologies or devices at the Coal Loader.

Students are encouraged to think not only about systems and devices but also consider water use behaviours and their impact on water consumption eg waiting until the dishwasher is full before use or hand washing if there are only a couple of items.

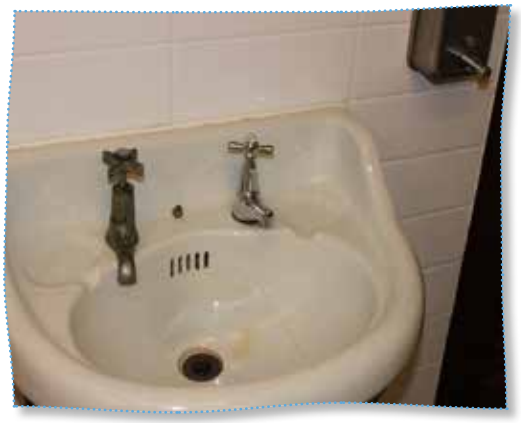
Located in the original caretakers cottage is a water and energy meter that displays data on the amount of water captured and used on site. In this activity students will use real time data from the meter to estimate the amount of water used per week.

Aim:

To be able to calculate the amount of water consumed at the Coal Loader and identify the different water saving devices and technologies used to conserve water.

Outcomes:

- An understanding of the importance of water saving and what systems, devices and behaviour can be used to reduce water consumption
- An ability to use real time water data to calculate consumption.



Reference Material:

Teachers may choose to provide students with the reference poster below or to discuss it as a class prior to coming to the site. Note that these posters are displayed on site, so time could be allowed for viewing them at the Coal Loader. They can be downloaded from *www.northsydney.nsw.gov.au/coalloader*, and a copy is included in Appendix 2.

- Poster – "Can you find our water tank?"

Materials & Preparation:

Students are to bring a clipboard or notebook, writing equipment and a calculator. Before commencing this activity teachers should review the background reading provided and lead a class discussion around water saving devices and behaviours.

Student Worksheet – Spot the Water Wise Design Features

Introduction:

This activity asks you to locate water saving technologies or devices at the Coal Loader, and to consider the water use behaviours of people at the site and their impact on water consumption eg waiting until the dishwasher is full before use or hand washing if there only a couple of items.

To complete this activity you will need to find the water and energy meter located in the former caretakers cottage. This interactive meter displays data on the amount of water captured and used by the Centre. In this activity you will use real time data from the meter to estimate the amount of water used per week.

Activity:

1. Look in and around the Coal Loader's former caretaker's cottage. Identify any water savings devices or systems. Record your findings in the table below

Location	Water saving device/system	What water saving behaviours could save even more water?
Kitchen		
Bathrooms		
Community Garden		
Jacaranda Square		
Other locations?		

2. Locate the energy and water display meter. Do visitors to the Centre have a noticeable impact the amount of water used? YES NO (circle answer)
3. Record three simple tips that could be used to help visitors and occupants reduce water consumption at the Coal Loader.

4. What is the difference between tank water and potable water?

5. Take a closer look at the water data for the past (7) days. What is the average amount of tank and potable water used per day?

   (a) Tank water

   (b) Potable water

6. For both tank water and potable water, at what time of the day is the most water used and why? Identify and explain any other patterns you can see

   (a) Tank water

   (b) Potable water

Extension Activity

7. Consider the water use at your school. What devices or systems could be utilised to reduce water consumption?

Activity 2 – Coal Loader Wetland Water Testing

Activity Summary:

This activity will illustrate how a wetland system works and how it can be used to improve the quality of stormwater on the Coal Loader site. During the activity students will be able to examine the macro-invertebrates living in the wetland and use a simple water testing kit to determine water quality. They will use their results as an indicator to determine the overall health of the wetland.

Aim:

To increase knowledge and awareness of how a wetland system can filter water to produce a better quality product, that in turn, can support many and varied life-forms.

Outcomes:

- A greater appreciation and understanding of the diversity of wetland ecosystems
- A greater understanding of wetlands and the importance of their role and function within our environment
- Learn how to classify insects and macro-invertebrates based on their physical appearance
- Begin to determine the quality of the water by identifying the diversity of insects living in the wetland
- Be able to use basic water testing equipment to help determine water quality (extension activity)

Equipment (provided by North Sydney Council):

- Dip net
- Rubber boots
- Rubber gloves
- Bucket
- Large open container
- Spoons
- Pipettes
- Magnifying glass
- Streamwatch Water Bug Guide
- Water quality testing kit (extension activity)

Students need to bring a notepad and writing materials and a copy of the Student Worksheet.

Reference Material:

- Poster – Coal Loader Wetland – *www.northsydney.nsw.gov.au/coalloader* or see Appendix 2
- Guide – Streamwatch Water Bug Guide – *www.streamwatch.org.au/cms/resources/manual_pdfs/BugGuide.pdf*
- Guide – How to perform basic water quality tests – *www.streamwatch.org.au/cms/resources/manual_pdfs/StreamwatchManual.pdf*

Preparation:

Before coming to the Coal Loader to complete this activity, teachers should lead a classroom discussion about what are aquatic macro-invertebrates and why they are a good indicator of wetland health. Some background information has been provided below.

This activity is best conducted in small groups (8 or less students). Teachers will need to supervise students at all times. Students participating in the dip netting and water testing will need to wear rubber boots and gloves, which can be provided by North Sydney Council.

Background Information:

Aquatic macro-invertebrates or water bugs are animals that have no backbone, are visible with the naked eye and spend all or part of their life in water. Aquatic macro-invertebrates are a very diverse group of animals that include worms, molluscs, arachnids, crustaceans and insects.

Why test aquatic macro-invertebrates?

Aquatic macro-invertebrates are excellent indicators of water quality and ecosystem health. This is because:

- They spend most or all of their lives in the water
- They are an important part of the aquatic food chain and therefore the wetland ecosystem
- Different species have varying sensitivities to pollution.

In highly polluted waterways only the most pollution-tolerant water bugs are able to survive. In pristine waterways all species are able to survive, even those that are very sensitive, resulting in a higher diversity of species.

Aquatic macro-invertebrates are relatively easy to collect and identify, and have been used extensively by environmental managers and researchers to assess water quality throughout Australia. Depending on the species found they can give an indication of the specific pollutants impacting on a body of water.

Further Information:

- Wetland Australia *www.wetlandcare.com.au*
- Streamwatch *www.streamwatch.org.au*

Student Worksheet – Coal Loader Wetland Water Testing

Introduction:

During this activity you will be able to examine the bugs living in the wetland and use a water testing kit to determine water quality. You will use your results as an indicator for the overall health of the wetland.

The wetland at the Coal Loader was constructed by a former caretaker of the site in the footprint of an old oil tank. The wetland acts as a filter, helping clean stormwater runoff from the site before it enters Sydney Harbour.

When it rains, the water from roofs and pathways, plus overflow from the rainwater tank, all flow into the man-made wetland. The water flows through a litter basket that strains out larger pieces of litter and debris, and then enters a pond which spreads and slows the gush of incoming water. This allows some of the debris and sediment in the stormwater to settle to the bottom of the pond.

The reeds and rushes planted in the pond filter out dissolved pollutants such as nitrates and phosphates, further slows down water flow, and draws floating solids to the bottom, which mixes with leaf litter. The sediment is soon converted to rich humus, much the same way as a compost heap works.

Appropriate water levels are maintained with a weir, through which cleaned water passes before flowing down a pipe and into Sydney Harbour.

Activity:

Walk down to the wetland accompanied by a teacher. Find a comfortable place to sit and record some basic site information in the table below before you start sampling the water.

Site Information

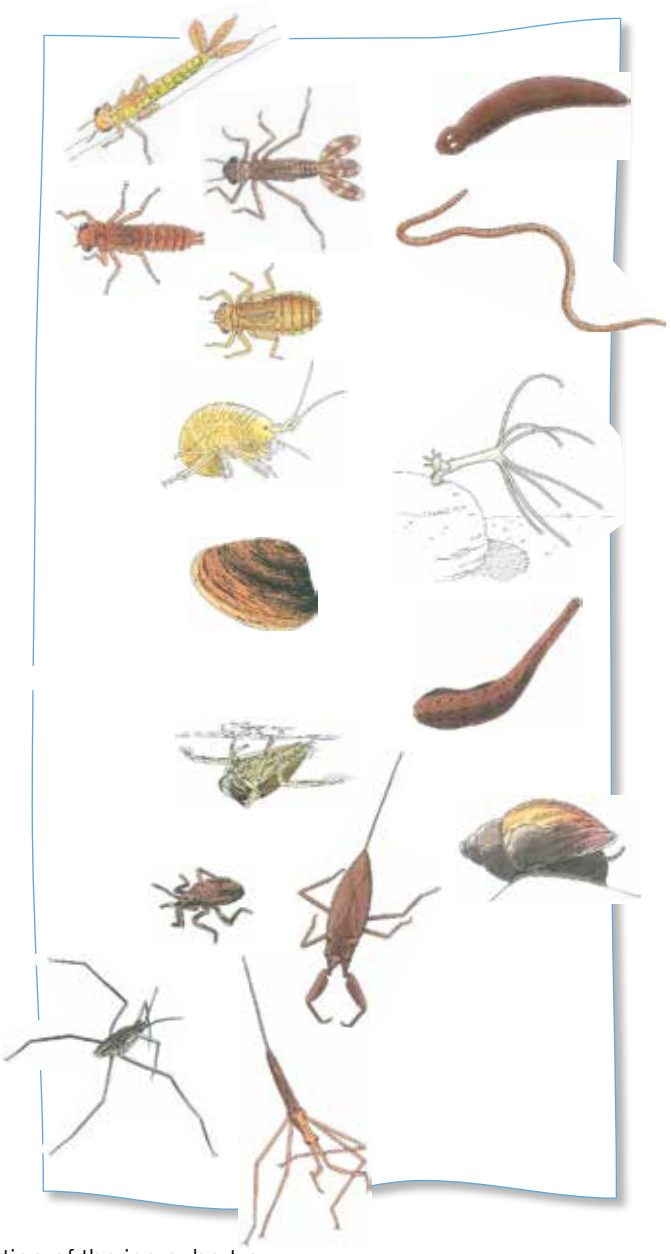
Site Name	Coal Loader Wetland		
Date			
Your school name			
Your name			
Water body type			
Location			
Site access			
Landowner name			
GPS reading		*Water flow*	
Former land use		*Native vegetation*	
Current land use		*Weeds*	
Site width		*Native animals*	
Water depth		*Other observations*	

Catching the Water Bugs

Check you have all the appropriate equipment for this activity including wearing rubber boots and gloves.

- One or two people at a time will use a dip net to catch the water bugs. You should try and catch bugs from deep, still areas with plants near the edge and shallow rocky areas. This way you will get a good variety of bugs
- Stay on the bank holding the net close to the edge of the water
- Spend a few minutes sweeping the net backwards and forwards trying to catch bugs (but not too much sediment)
- Spend about 10 minutes catching bugs
- Holding the net upright, rinse it in the water to remove some of the sediment
- Turn the net inside out over a bucket and tip the entire contents into the bucket. Wash some water over the net to ensure everything gets into the bucket.

Repeat this process if you have time, and try to sample a different spot.



Sorting Out the Water Bugs

Find a safe place to look at what you have caught. Use a sorting tray and an ice cube tray to sort out the bugs.

- Pour the water containing the water bugs from the bucket into the sorting tray.
- Use spoons and pipettes to remove each bug from the sorting tray and put it in a section of the ice cube tray (half filled with water).
- Put the same type of bugs together in each section of the ice cube tray.

Working Out What Bugs You Have

- Compare the bugs in the ice cube tray to the ones pictured on your Water Bug Guide to help work out what they are.
- Use a magnifying glass to get a better look

How healthy is this waterway?

Record your results in the Streamwatch Pollution index table opposite.

How to calculate weighting:

Abundance	Weighting
1-5	1
6-15	2
>15	3

Streamwatch Pollution Index Sheet

	Common name	Scientific name	Bug value (tolerance measure)	Abundance (number of each bug)	Weighting	Bug value x weighting
Very sensitive	Mayfly nymph	Ephemeroptera	10			
	Cadisfly larvae	Tricoptera	10			
	Stonefly nymph	Plecoptera	9			
	Freshwater crayfish	Parastacidae	8			
Sensitive	Dobsonfly larvae Scorpionfly larvae	Megaloptera Mecoptera	7			
	Water mite	Acarina	6			
	Beetle larvae	Coleoptera	6			
	Beetles adult	Coleoptera	5			
	Freshwater sandhopper	Amphipoda	4			
	Dragonfly larvae	Odonata	4			
	Damselfly larvae	Odonata	4			
	Freshwater shrimp	Atyidae	4			
	Nematodes, Nematomorpha	Nematoda	4			
	True bug – water strider/ measurer/ treader	Hemiptera – on water surface	4			
Tolerant	Flatworm	Turbellaria	3			
	Freshwater slater	Isopoda	3			
	Freshwater mussel	Bivalvia	3			
Very tolerant	Hydra	Hydrozoa	2			
	Fly larvae (flies, mosquitoes, bloodworms)	Diptera	2			
	True bugs – back swimmer boatman, water scorpion	Hemiptera – found under water	2			
	Leeches	Hirudinea	2			
	Copepods, seed & clam shrimps, water fleas	Copepoda	1			
	Freshwater snails	Gastropoda	1			
	Aquatic earthworm	Oligochaeta	1			
						TOTAL

Source: How to calculate weighting: Streamwatch Manual *www.streamwatch.org.au/cms/resources/manual_pdfs/StreamwatchManual.pdf*

Make sure you add up the column total!

Questions:

1. Using the Stream Evaluation Chart below, rate the water quality in the wetland.
   Poor *Fair* *Good* *Excellent* (circle your answer)

Stream Evaluation Chart

Column Total (bug value x weighting)	Water Quality Rating
0-20	Poor
21-80	Fair
81-150	Good
>150	Excellent

2. What key factors do you think could be impacting on the water quality of the wetland?

Extension

3. If you have access to water quality equipment, eg a Streamwatch kit, measure other key indicators of water quality of the wetland at the Coal Loader eg pH levels, turbidity and dissolved oxygen. How does this compare to drinking water?

4. List (3) practical actions you could take at home or at school to improve the water quality of stormwater runoff

Activity 3 – School Water Audit

Take away activity – for home or back at school

Activity Summary:

This activity will use a water audit to survey the quantity and quality of all the school's water devices, check where water is used, and identify opportunities for saving water.

In this activity students will learn how to conduct an audit and then work in groups around the school to collect data. They will then return to the classroom to collate results. A template audit recording sheet has been provided for your use. A simple video produced by Sydney Water can be watched beforehand to help explain the audit process.

Aim:

To identify where the most water is used at school and what could be done to reduce overall water consumption.

Outcomes

- Students learn where most water is consumed and explore different water-efficient devices.
- Students will learn how to conduct an investigation, collate information and interpret investigation results.

Materials & Preparation

- DVD – 'How to do a water audit' (one free copy is available for each school in Sydney Water's area of operations. Call 1800 724 650).
- DVD player
- Water audit recording sheet (provided)
- Map of school grounds. The school should be divided into five roughly even areas and each group's audit area individually marked with a highlighter pen (Tip – the group that has the least number of buildings/rooms to be audited could also be allocated all outside taps)
- Five measuring jugs
- Blackboard, overhead or interactive whiteboard to collate results.

Reference:

The water audit methodology has been adapted from *Sydney Water School Water Audit Guide*. It is recommended that teachers read this guide as background information before commencing the activity.

Further Information:

Sydney Water *www.sydneywater.com.au*

Student Worksheet – School Water Audit

Introduction:

Do you know how many taps your school has or how many bubblers are leaking? This activity gets you to conduct a water audit on your school. You will collect information about your school's water system to see how efficient it is.

By doing a water audit you can find out:

- how many water fixtures and fittings your school has
- how many are efficient
- which areas of the school could be improved

After conducting the water audit you are encouraged to present your findings to the school and prioritise any areas that that could be improved to save water and money.

Activity:

1. Organise yourselves into five groups and name them. Your group will be provided with a Water Audit Student Worksheet and an A3 map with your audit area highlighted. It is important that your group stays in your area to avoid double counting.
2. Allocate a scribe for each group.
3. Familiarise yourselves with the Audit Worksheet. These will be tallied as a class total at the end of the audit period.
4. Hints on filling in the Worksheet:
    - Column 2 – Tally all water devices in your survey area under column two.
    - Column 3 – For each device, record any water saving features eg spring-loaded taps, headless taps, waterless urinals, low flow showerheads or dual flush toilets.
    - Column 4 – Tally any broken/leaking appliances and write their location in the appropriate column. Broken devices cannot be turned off.
    - Column 5 – Dripping devices are those that are not turned off tightly enough. These can be turned off during the audit.
5. If rooms (particularly storerooms) are locked, you could ask a nearby teacher to unlock it or help them fill in the sheet.
6. If your school is mixed gender, ensure at least one boy and one girl are in each group to cover any toilets in your area. Note – each urinal is counted as one device even though there may be several water outlets.
7. You will have around 30 minutes to complete your audit. You must return to the classroom when you have finished auditing or when time is up.
8. Complete the audit and write your results in the Water Audit Student Worksheet opposite.

Our School's Water Audit – Student Worksheet

Water devices	Number of devices	Number of water efficient devices	Number broken or leaking and their location	Number dripping
Toilets				
Urinals				
Bubblers				
Taps				
Zip hot water heaters				
Showers				
Other				
Group total				
Class total				

If possible, find a dripping tap and use the measuring jug and watch/timer to work out how much water is wasted in one minute. Fill in the table below to work out how much water is wasted from the tap.

A	B	C	D	E
Water lost in one minute	Water lost in one hour (A x 60)	Water lost in 24 hours (B x 24)	Converted to litres (C/1000)	Water lost in one year (D x 365)
mL	mL	mL	L	L

Water Audit Results:

- Copy the audit sheet either onto the blackboard, an overhead or an interactive white board. Ask each group's scribe to fill in their results in the appropriate area to get a class total.
- Prepare a list of broken or leaking appliances to give to the school's general assistant to fix.

Extension

- Discuss the class results and devise an action plan to improve school water efficiency.

You may like to use the Water Efficiency Action Plan template from Sydney Water *http://www.sydneywater.com.au/Publications/_download.cfm?DownloadFile=../Education/doc/3-5-4-3efficiencyplanteachers.doc*