Junior Waterwatch Field Manual

A complete manual for on-site use by teachers and Stage 2–3 students monitoring their local waterway

waterwatch
NEW SOUTH WALES
Communities Caring for Catchments

NSW GOVERNMENT
Environment, Climate Change & Water

Australian Government

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How to use this manual

This *Junior Waterwatch Field Manual* and the accompanying *Junior Waterwatch Teachers' Guide* have been designed to provide a complete guide to designing and implementing the Waterwatch program within primary schools in New South Wales, to meet curriculum outcomes.

The methods and procedures described combine best practice and scientific rigour with straight-forward instructions, to ensure students gain maximum benefit from participation while also contributing high quality data to the Waterwatch database. Such data becomes a valuable tool for natural resource managers to use in catchment planning.

This field manual for teachers and students provides background information, detailed instructions and numerous student work sheets, to make visits to your chosen site a valuable learning experience resulting in high quality data. This resource is intended for use on-site and will guide students as they develop essential scientific skills and gain a first-hand insight into their local catchment.

The manual is divided into numbered sections:

Section 1: Assessing your site
Section 2: Junior Waterwatch equipment
Section 3: Testing water quality in the field
Section 4: Student procedure sheets
Section 5: Interpreting your results
Section 6: Habitat assessments
Section 7: Water bug (macroinvertebrate) survey
Section 8: Human impacts on waterways

This field manual is to be used in conjunction with the *Junior Waterwatch Teachers' Guide* and contains cross-references to that document.

Learning by doing is often the best way. Waterwatch offers a way for your students to get involved in monitoring the health of their environment and to take part in managing some of the problems.

Congratulations on your involvement in Waterwatch!

Table of contents

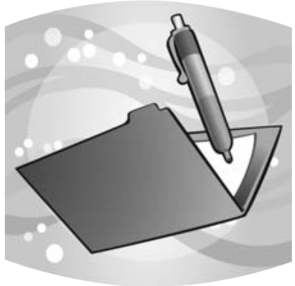
SECTION 1

Assessing your site

Site assessment is the preliminary work done to get an overview of your proposed site prior to beginning any water quality testing.

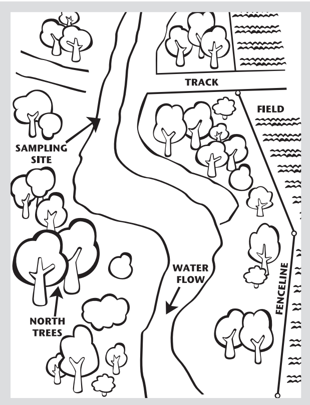
This section of the field manual contains a series of work sheets, checklists and some background information to assist students to do a detailed assessment of the site you have chosen for investigation.

1.1 Draw a location map for your site work sheet



Site name: ....

Date: ....

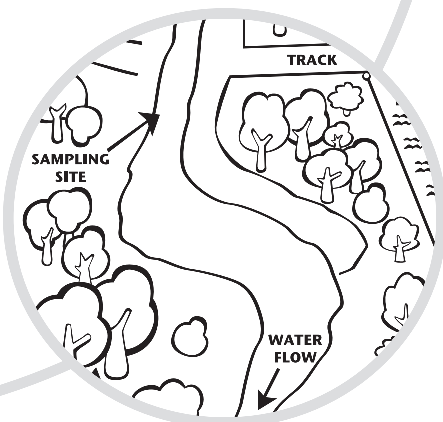


1.2 Draw a bird's eye view map of your site work sheet

Site name: ....

Date: ....

Imagine you are a bird flying over your site.
What would it look like? Draw in the shape and label the key features.
Your map may look something like the sketch below.



1.3 Photopoints of your site work sheet

Take a photo of your site

Site name: ....

Date: ....

Find a location at the site where you can take a photograph upstream and downstream.
This is called a photopoint. It will be used to take a photo at least twice per year.
This will show seasonal and other changes at your site. The photopoint may be a large tree, signpost or other easily recognisable feature.

My photopoint is: ....

Upstream	**Downstream**

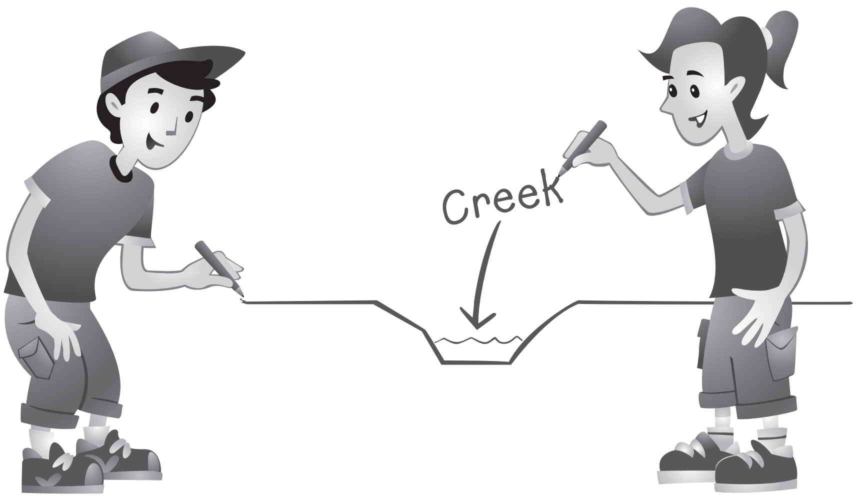
Your photos may provide a record of changes at your creek over time.

1.4 Land use close to the waterway work sheet

Site name: ....

Date: ....

Draw in and name the main land use on each side of your creek.



1.5 Site assessment for the online database

Note: This assessment is essential when setting up a site on the Waterwatch online database. Due to its complexity, it may be more appropriate for teachers to complete this assessment.

Site name: ....

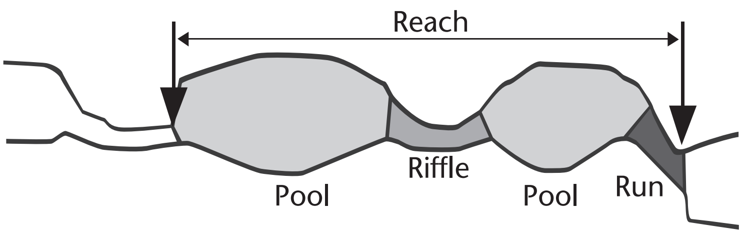
Date: .... Time: ....

Fill in the information below and tick the boxes to provide an assessment of your monitoring site. If any parts of the assessment are **not** relevant to your site, write N/A.

Water body type

Circle the water body type in the table below that best describes your site:

Freshwater rivers and streams	Estuary/marine	Standing water (fresh)
Upland river >150 metres	Estuary	Lakes/reservoirs
Lowland river <150 metres	Coastal stream (tidal)	Dam
		Wetland

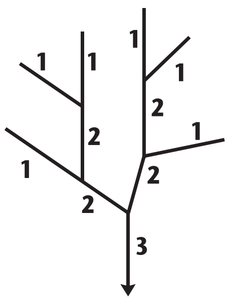


Site study area

For rivers and creeks **only**

Length of reach or bank: assessed .... metres

Stream order: 1st or 2nd order (mainly small non-perennial streams)
≥ 3rd order (mainly larger perennial streams)



Upstream and downstream site comparison

Tick the two boxes that best describe sites upstream and downstream of your site.

Up-stream (tick)	Features compared to my site	Down-stream (tick)
☐	Similar to my site	☐
☐	More disturbed	☐
☐	Less disturbed	☐
☐	Undisturbed (natural) area	☐
☐	Wetland	☐

Does the current health of your site impact on sites lower in the catchment?

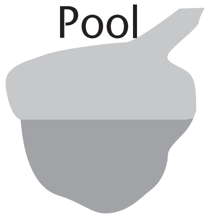
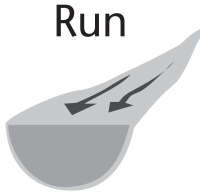
☐ Yes ☐ No ☐ Unknown

Does the current health of upstream sites impact on your site?

☐ Yes ☐ No ☐ Unknown

In-stream features

Natural

	Tick
Pool 	☐
Riffle 	☐
Run 	☐
Other (name)	☐

Artificial

	Tick
None	☐
Dam/weir upstream	☐
Water diversion upstream	☐
Weir pool at site	☐
Constructed wetland at site	☐
Other structures that affect flow (name)	☐

Banks

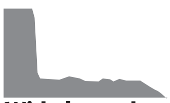
Looking downstream

Bank height

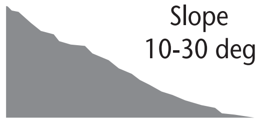
Left bank (tick)	Height in metres	Right bank (tick)
☐	0–2	☐
☐	2–5	☐
☐	>5	☐

Bank shape

The banks at the site have the following shape. (Tick the shape that best matches your left and right bank.)

Left bank (tick)	Slope	Right bank (tick)
☐	 **Concave**	☐
☐	 **Convex**	☐
☐	 **Stepped**	☐
☐	 **Wide lower bench**	☐
☐	 **Undercut**	☐
☐	Artificial banks	☐

The slope of the bank can be described as:

Left bank (tick)	Slope	Right bank (tick)
☐	Slope 80-90 deg.  **Vertical**	☐
☐	Slope 60-80 deg.  **Steep**	☐
☐	Slope 30-60 deg.  **Moderate**	☐
☐	Slope 10-30 deg.  **Gentle**	☐
☐	Slope <10 deg.  **Slight**	☐

Bank erosion

Looking downstream

Tick the box that best describes erosion at the site.

Left bank (tick)	Erosion	Right bank (tick)
☐	Severe	☐
☐	Moderate	☐
☐	Little or no erosion	☐

Bank stability factors

Looking downstream

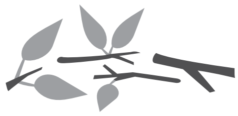
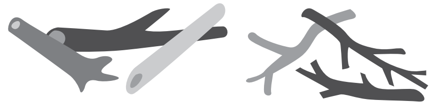
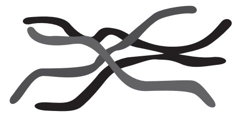
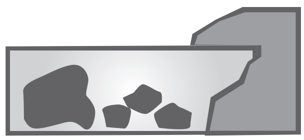
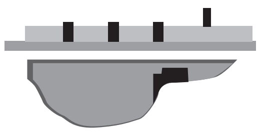
Tick the boxes that best describe factors affecting bank stability at the site.

Bank stability factors	Tick
None	☐
Stock access/crossing	☐
Vehicle tracks	☐
Roads/jetty/bridges	☐
Cleared vegetation	☐
Gravel and sand extraction	☐
Mining	☐
Unfenced riverbanks	☐
Pipes/drains	☐
Other (name)	☐

Erosion control structures at the site

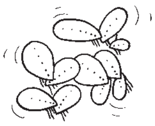
Structures at the site	Tick if visible
None	☐
Fences	☐
Concrete-lined channel	☐
Concrete/rock wall/basket	☐
Logs strapped to banks	☐
Breakwater	☐
Other (name)	☐

In-stream habitats

In-stream habitat	Tick if present
Leaves and twigs 	☐
Logs/branches 	☐
Tree roots 	☐
Water plants 	☐
Silt/sand 	☐
Stones/pebbles 	☐
Human made structures 	☐

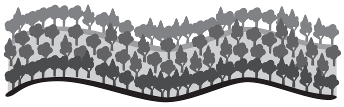
Aquatic plants

Identify the form of the aquatic plants by ticking the boxes if present.

Habitat and form	Tick if present	Plant name
Free-floating 	☐	
Floating but attached 	☐	
Submerged (not feathery) 	☐	
Submerged and emergent (feathery) 	☐	
Emergent (narrow leaf) 	☐	
Emergent (broad leaf) 	☐	

Riparian vegetation along banks

For your site, tick the box that best describes vegetation along the banks.

Features of riparian vegetation	Left bank (tick)	Right bank (tick)
Wide corridor of mainly undisturbed native vegetation 	☐	☐
Well vegetated with native and/or introduced species 	☐	☐
Narrow corridor of native and/or introduced species 	☐	☐
Clumps of native and/ or introduced species 	☐	☐
Little or no riparian vegetation 	☐	☐

Local land use

Tick land use	Land use	Percent
☐	Cropping	
☐	Grazing	
☐	Urban	
☐	Industrial	
☐	Mining	
☐	Fishing	
☐	Recreation	
☐	Native bushland, reserves or wetlands	
☐	Other (name)..	

Significant Aboriginal landscape features

Does your site have landscape features of Aboriginal significance?
Tick the boxes below to identify these landscape features.

Category	Landscape feature	Tick
Waterways	Permanent/temporary waterways	☐
	Permanent/temporary wetlands	☐
	Fish traps	☐
Riverbanks	Stone artefacts/scatters	☐
	Campsites	☐
	Shell middens	☐
Topography	Caves/overhangs	☐
	Elevated areas with long sight lines	☐
Vegetation	Scar trees	☐
	Carved trees	☐

1.6 Student site summary checklist

(To be done the first time you visit your site.)

Name of group:
Site name:
Date: Time: AM/PM
Catchment or sub-catchment:

Answer the following questions by ticking the box which best describes your site today.

My waterway is:

☐ wide and shallow (more than 20 metres across)

☐ deep and still

☐ fast-flowing water

☐ other (describe) ....

....

....

....

....

The depth of the water at my site is:

☐ deep (over my head)

☐ medium (up to my waist)

☐ shallow (up to my ankles)

The bottom of my creek is:

☐ sandy

☐ muddy

☐ rocky

What types of trees, shrubs and grasses are growing on the banks?

- ☐ native trees and shrubs
- ☐ reeds and grasses
- ☐ non-native trees and shrubs (e.g. olive, ash, willow and blackberry)
- ☐ weeds

Do you have plants growing in the water at your site?

- ☐ plants attached to the bottom of the creek/river but with stems, flowers and most leaves above the water
- ☐ plants attached to the bottom of the creek/river growing underwater
- ☐ plants floating on top of the water and not attached to the bottom
- ☐ algae

Are any of the following at or near your site?

☐ factories ☐ shops ☐ market gardens ☐ houses ☐ parks

☐ farms ☐ orchards ☐ vineyards ☐ native bushland/reserve

Does the site have stormwater outlets or drains at or near it?

If yes, how many? ....

Are there any other important features of your site?

....

....

....

....

....

....

....

....

....

1.7 Student site observation checklist

Name:	
Site name:	
Date:	Time: AM/PM
Catchment/sub-catchment:	
Location:	

Answer the following questions by ticking the box which best describes your site today.

What is the weather like today?

☐ sunny ☐ cloudy ☐ light rain (showers)
☐ heavy rain

What has the weather been like for the last two days?

☐ sunny ☐ cloudy ☐ light rain (showers)
☐ heavy rain

Draw a picture of your site.

Rate your site

Circle the most correct answers for each site feature.

Site features	Good	Fair	Poor
Bottom	Can see the bottom – clear	Can see the bottom but milky or bubbles	Cannot see the bottom – brown, green
Top	Clear	Cloudy/bubbles	Green algae cover top
Smell	Does not smell	Petrol, fishy, other	Sewage
Appearance	No litter	Small amount of litter, oil or other human-made matter	Large amount of litter, oil or other human-made matter
Other pollution	None	Some pollution	High level of pollution

Rate the health of your site

1. Add up the number of good results.
2. Rate the health of your site using the table below.

Number of good results	Rating
0	**Very poor**
1–2	**Poor**
3–4	**Fair**
5	**Good**

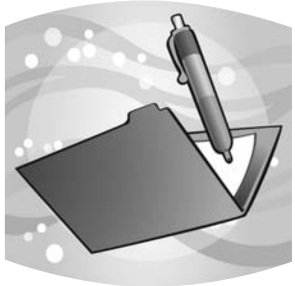
Good results:	Rating:

1.8 Landscape features of Aboriginal significance background information

Waterways	**Aboriginal significance**
Stream, river, wetland or watercourse	Waterways are significant to Aboriginal people for fish, food (bush tucker), water, medicines, trade routes and storylines.
Hanging swamps	Hanging swamps are significant ceremonial areas (women).
Fish traps	Food – fishing.
Riverbanks	**Aboriginal significance**
Open campsites	These areas contain evidence such as food debris, charcoal and implements.
Shell middens	Shell middens provide an indication of aquatic environments used by Aboriginal people and seasonal and annual patterns of use. Middens are found along the coast and near inland waterways and billabongs. Burial sites may be contained within middens.
Stone artefacts/scatters	These may identify camping, trade or food preparation sites. When many artefacts are present at one site, it may be a rock quarry (extraction of stone) or knapping site (making tools).
Axe grinding grooves	Sharpening and shaping of stone implements.
Riparian vegetation	**Aboriginal significance**
Riparian vegetation	Riparian vegetation provided food (bush tucker), medicines, habitat for animals, or indicators of seasonal arrival of plants/insects/animals.
Riparian vegetation	Bark was used for making coolamons, canoes or humpies. Coolamons were used to carry food, water, children or tools and may also have been used as a floatation device.
Scar trees	The presence of canoe scars indicates the use of the area for fishing, trade or river crossing during floods.
Carved trees	Carved trees indicate significant sites such as initiation grounds, boundary markers or grave sites.

<table>
<tr><th>Landscape features</th><th>Aboriginal significance</th></tr>
<tr><td>Rocky or sandy hills, mountains, claypans, or rock shelters including caves and sandstone overhangs</td><td>Outcrops of rock such as sandstone or granite overhangs may form cave-type shelters. They may contain Aboriginal rock art sites, campsites, ceremonial sites, burial grounds or other significant Aboriginal sites.</td></tr>
<tr><td>Elevated sites with long sight lines</td><td rowspan="2">These areas provide vantage points to observe landscape features and the movement of animals and people. They can be important for protection of men’s and women’s sites, greetings and may also be spiritual sites.</td></tr>
<tr><td>Large rock outcrops surrounded by flat plains</td></tr>
</table>

1.9 Landscape features of Aboriginal significance checklist



Site name: ....

Date: ....

The following site features are significant to Aboriginal people.

Look around the site and tick the boxes to indicate the features that are at your site.

Landscape features of Aboriginal significance

The landscape features of Aboriginal significance at your site:

☐ rocky hills ☐ sandy hills ☐ mountains ☐ caves

☐ overhanging rock ledges ☐ a high point with a long distance view

These provided campsites, burial sites and rock art sites and points to observe landscape features and the movement of animals and people.

Water features of Aboriginal significance

Waterways at your site of importance to Aboriginal people:

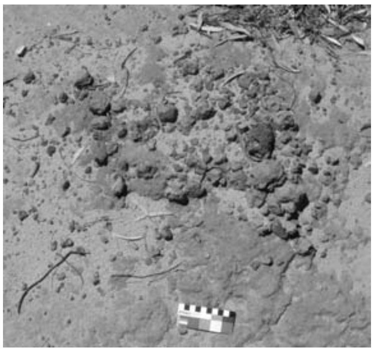
☐ river ☐ creek ☐ billabong ☐ lake ☐ estuary

☐ other waterway (please state) ....

Waterways are significant for fish, food (bush tucker), water, medicines, trade routes and storylines.

Riverbank features

Many Aboriginal people lived on or near riverbanks.
Evidence of Aboriginal use of this site:



☐ **Open campsites**
These sites have stone scatters, bones, burnt clay nodules or charcoal in a selected area.

☐ **Shell middens**
Many shells built up in one area.
These are the remains of shellfish and mussels.

☐ **Stone artefacts and scatters**
These include stone axe heads, grinding stones or small cutting blades and angular stones.

Waterway features

☐ **My site has water all the time (do not include dams).**
Rivers were used by Aboriginal people for transport and trade.

☐ **My site has stones arranged in a pattern in flowing water.**
Aboriginal people made fish traps by arranging stones in flowing water in a design (circle, semicircle or square).

Living things of importance to Aboriginal people near rivers

Native vegetation:

☐ **Native trees**

Native trees provide food, fuel, bark for canoes, shelters and other uses.

☐ **Scar trees**

These are large trees that may have been used to make canoes or coolamons (small wooden carved-out bowls).

☐ **Carved trees**

These are trees that have geometric patterns or designs carved into the trunk.

☐ **Large native trees such as river red gums**

These trees were used by Aboriginal people to make canoes and coolamons (small wooden carved-out bowls).

Water plants

Water plants important to Aboriginal people:

☐ bulrush/cumbungi ☐ reeds ☐ rushes ☐ spike-rushes

Water plants were used for food and equipment. They also provided edible roots that are a good source of carbohydrates. Bulrush roots were chewed and used to make string for nets.

Waterbirds

Common species of waterbird important to Aboriginal people:

☐ native ducks ☐ black swan ☐ brolga ☐ pelican ☐ egret

Waterbirds and their eggs were taken for food during nesting seasons.

Water bugs and other animals

Water bugs and animals important to Aboriginal people:

☐ mussels ☐ shrimp ☐ other shellfish ☐ water rats ☐ platypus

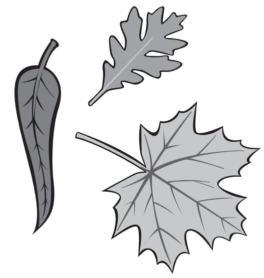
Shellfish and crustaceans were collected for food.

1.10 A treasure hunt at my site

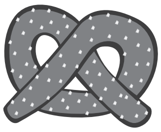
1. Collect the things listed below and place into a small bag or container.
2. Sort out the items collected.
3. Describe the items you have collected.

10 different things to find

1. 3 leaves of different colours

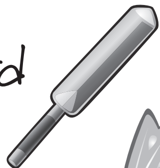


2. something brown

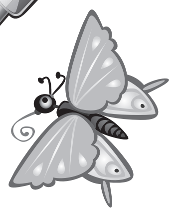


3. something tiny

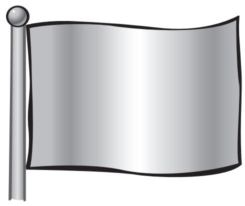
4. something hard



5. something soft

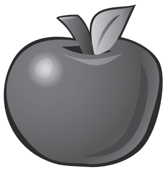


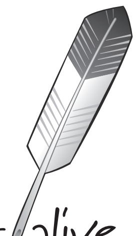
6. something which looks like a rectangle



7. something which looks like a circle

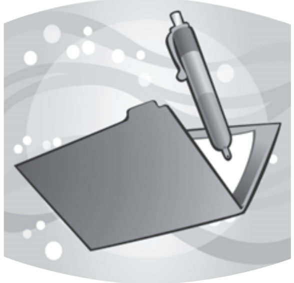
8. something smooth





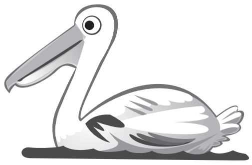
9. something not living but comes from something alive
10. something which smells good

1.11 Things I can see at my site work sheet

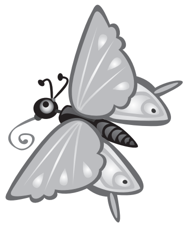


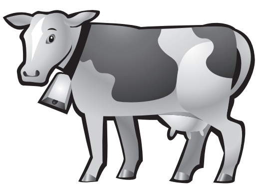
Site name: ....

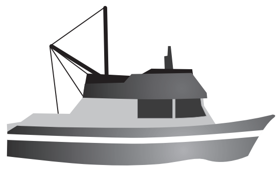
Date: ....



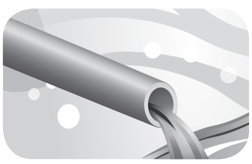
Natural things







Human-made things

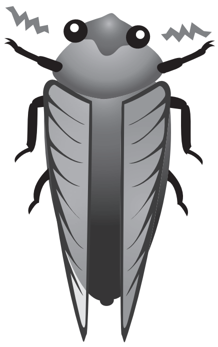


1.12 My sound map work sheet

Site name: ....

Date: ....

Close your eyes and listen to the sounds of your site.
Write down what you hear and where it is.

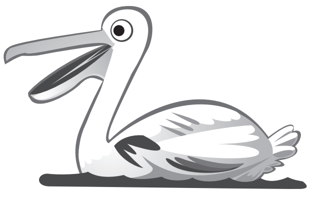


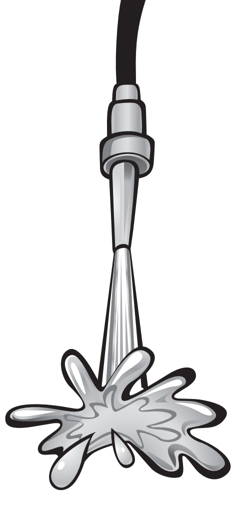
ME

Animals would be happy when the river is:

☐ noisy

☐ quiet



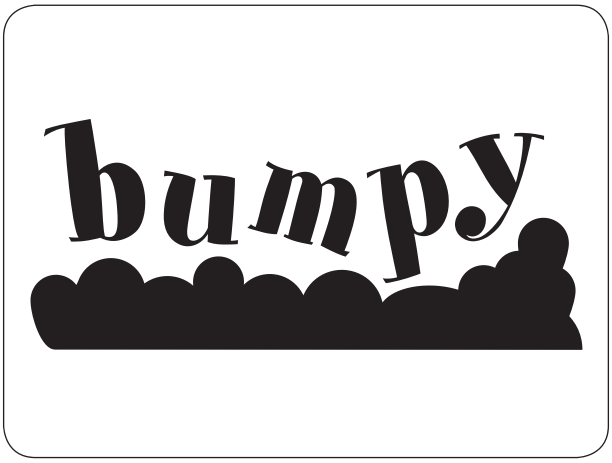


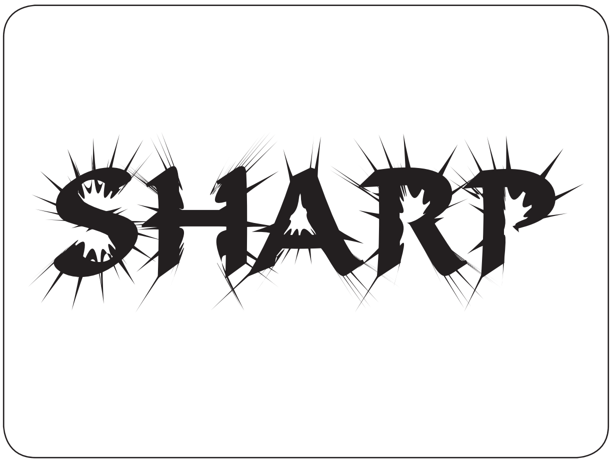
1.13 How does it feel? work sheet

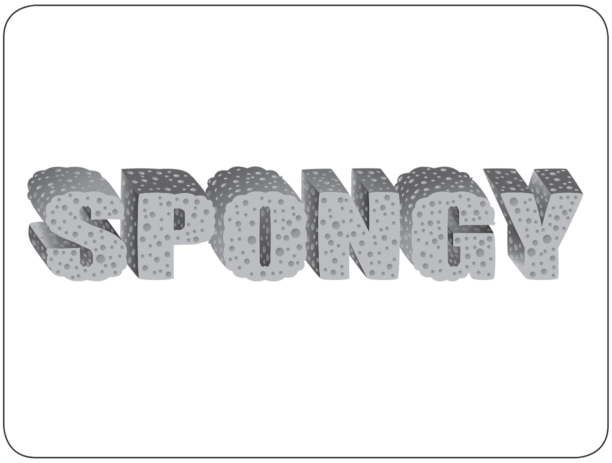
Photocopy enough cards for each student to have 3 each. There is another set of cards on the next page.

At the site, students select cards and find objects fitting each description.

Are they in the built or natural environment?







Beautiful

SHINY

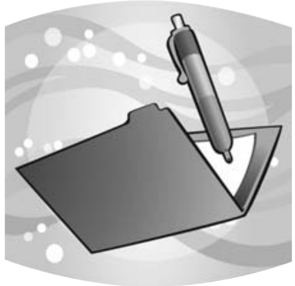
Smooth

Rough

DRY

Prickly

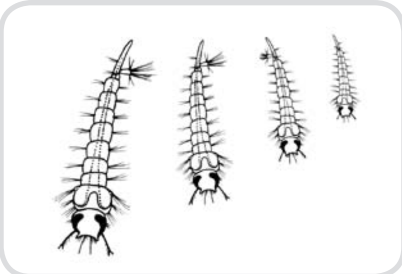
1.14 Natural changes at the site work sheet

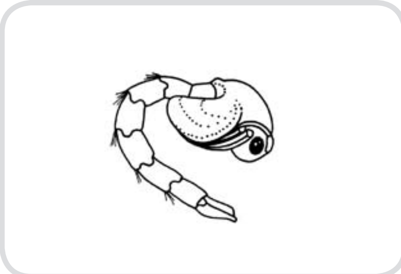


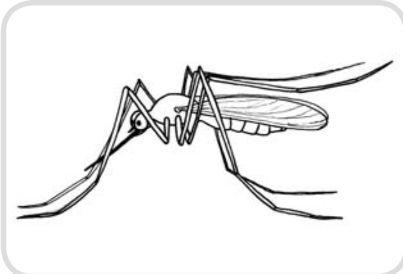
Site name: ....

Date: ....

In nature, things are always changing.







In the boxes below, draw pictures to illustrate the changes that take place at your site.

SECTION 2

Junior Waterwatch equipment

There are a number of specialised pieces of equipment for measuring the various parameters used to evaluate the health of a waterway. These are all provided in the Junior Waterwatch kit available from your local Waterwatch Coordinator. The provisions in the Junior Waterwatch kit can also be supplemented by equipment commonly found in school science classrooms or by tools such as nets created by the students themselves.

This section of the manual lists equipment needed to conduct water quality tests and how to care for it. Detailed instructions are provided for calibrating specialised devices such as electrical conductivity (EC) meters, and converting between various units of measurement.

2.1 Equipment list and the Junior Waterwatch kit

Measuring equipment

Equipment	Measurement unit	Purpose
Turbidity tube	Nephlometric turbidity units (NTUs)	Clarity of water
Electrical conductivity (EC) meter	mS/cm; µS/cm	Salinity – surface and groundwater
Thermometer	°Celsius	Air and water temperature
pH papers	0–14 pH scale	Acidity/alkalinity

Things to help collect your sample

Water sampling bottles

Sample containers

Extension pole and water sampler

Specimen containers

Things to maintain your equipment

Calibration liquid

Deionised water

Wash bottle

Disposing of waste

Waste container

What can you add from school?



Extra thermometers
Clipboards
Water bug equipment
Microscope
Binoculars
Camera
Stopwatch
Tape measure

The Junior Waterwatch kit

The Waterwatch kit contains all the equipment needed for a class activity to monitor surface water in rivers, creeks, dams, wetlands and estuaries. An additional collector (can be made at home) and tape measure will be required for groups to monitor groundwater.

The Waterwatch kit contains multiple specimen containers and turbidity tubes to ensure that all students are actively engaged in Waterwatch activities. All kits can be equipped to suit the needs of individual groups.

The kit may be a black suitcase (below) or may be a storage box purchased from a local hardware or variety store.

The primary school kit contains **no** acids or chemicals.

It is **safe** for primary school-aged students.

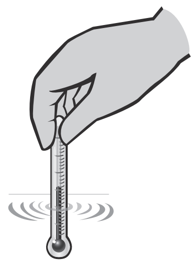
Junior Waterwatch kit contents

Turbidity tubes
Water sample bottles
Specimen containers
Small beaker
Deionised water
Calibration liquid
EC meter
pH papers
Armoured thermometer

2.2 Caring for your equipment

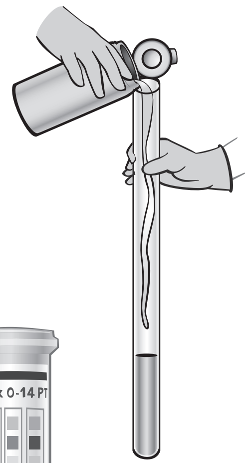
Thermometer

Store the thermometer in a cool place. If the blue alcohol liquid in the tube develops bubbles or separates, run gradually warmer water along the tube until the bubbles disappear or the liquid rejoins.

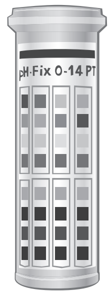


Turbidity tubes

Turbidity tubes should be kept clean. Rinse after use, and wash periodically in warm soapy water. Apply petroleum jelly lightly to the join occasionally for ease of assembly.



pH papers



Dispose of pH papers into a solid waste container.
Never leave the papers on the bank of the creek or river.

Electrical conductivity (EC) meter

Keep the meter in a cool place and replace batteries regularly as flat batteries will produce inaccurate results.

Immerse only the probes of the meter in the water and rinse them with deionised water after use.

Calibrate the meter regularly for accurate results.

2.3 Measuring electrical conductivity and total dissolved solids

Salinity is measured using an EC or TDS meter. Look carefully at your meter to determine the type of meter you are using and select the appropriate procedure sheet from Section 4.
Most Waterwatch groups use an EC meter. EC meters measure electrical conductivity in µS/cm or mS/cm (= dS/m). A dual range meter measures both µS/cm and mS/cm.

> *i* **If you have problems identifying your meter, contact your Waterwatch coordinator.**

EC meters

Type of meter	Range	Unit of measurement	Comments
ECScan Low ECScan High	0–19999 0–19.99	microsiemens/centimetre (µS/cm) millisiemens/centimetre (mS/cm)	No conversion required Convert mS/cm to µS/cm x1000
ECTestr 11 and 11+ Dual Range	0–19999 0–19.99	microsiemens/centimetre (µS/cm) – low range millisiemens/centimetre (mS/cm) – high range	Measurement changes from µS/cm to mS/cm as higher levels of salt are recorded. Convert mS/cm to µS/cm x1000

Converting units of measurement

> *i* **Measurement tip: 1 mS/cm = 1000 µS/cm**

Electrical conductivity (EC)

1000 µS/cm = 1 mS/cm = 1 dS/m

To convert µS/cm to mS/cm or dS/m, **divide** by 1000

To convert mS/cm or dS/m to µS/cm, **multiply** by 1000

2.4 Using your EC meter

What does the EC meter measure?

As salts conduct electricity, electrical conductivity (EC) can be used to estimate the amount of salt in a water sample or soil/water solution. EC readings increase as salinity levels increase.

Waterwatch kits contain a low or high or dual range EC meter.

- **Low range** meters are for use in freshwater areas with low levels of salinity.
- **High range** meters are best for saline areas (and coastal streams) or for monitoring groundwater.
- **Dual range** meters are best when testing at sites where there are large differences in salinity, such as along a coastal stream influenced by tides or when measuring surface water and groundwater.

> **Tip:** **Make sure you use the procedure sheet that corresponds to the type of meter you have.**

All meters have the following features:

- waterproof and float
- replaceable sensors
- push button calibration (and automatic calibration for dual range meters)
- automatic temperature compensation
- auto off after 8.5 minutes.

Additional features of the ECTestr 11 and 11+ are:

- automatic and manual calibration
- ability to calibrate to different EC ranges
- temperature readings in °C or °F.

Specifications for the ECScan and ECTestr meters

Meter	Salinity measure	Range	Resolution	Calibration standard solutions
ECScan High	mS/cm	0–19.9	0.01 mS/cm	12.88 mS/cm
ECScan Low	µS/cm	0–1999	1.0 µS/cm	1413 µS/cm or 500 µS/cm
ECTestr 11 and 11+	mS/cm µS/cm	0–20 High 0–2000 Low	0.1 mS/cm 10.0 µS/cm	12.88 mS/cm 1413 µS/cm, 84 µS/cm

Note: Meters should be calibrated with a solution that is similar in EC to the water tested.
The dual range meter can be calibrated in both low and high ranges.

Error messages

If the salinity is out of range, your meter display will show the letters ‘OR’ (over range). To overcome this problem you need to dilute the sample.

Meter maintenance

Calibrate the meter before each use.

Rinse the electrodes with deionised water and dry in the air or by blowing on the probes, including between samples.

If the electrodes become green, dirty or rusty, soak them in methylated spirits for 10–15 minutes and then blow or wipe dry with a cotton bud.

Ensure the batteries are replaced regularly for accurate readings.

Calibration

What is calibration?

Calibration means adjusting the meter reading to ensure it conforms to a known salt solution. It is advisable to calibrate your meter with a solution similar to the EC of your waterway.

Calibration ensures the accuracy of data and should be done each time you use the equipment. Meters must be calibrated regularly to ensure consistent readings

Calibration procedure

1. Use a standard calibration solution. This may be 500 µS/cm, 1413 µS/cm or 12.88 mS/cm.
2. The calibration liquid should be at **room temperature**.
3. Pour a small amount of calibration solution (about 2–3 cm) into a small clean container, such as a film canister.
4. Turn the conductivity meter on and place the electrodes in the solution.
5. Wait for the display to stabilise. If the meter does not read the same as the known calibration solution, you will need to calibrate.

> *i* **Testing tip: Calibration liquid must be made in a NATA accredited laboratory or purchased from a commercial supplier.**

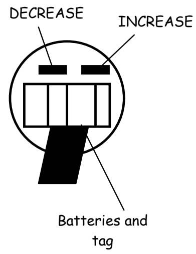
Calibrating by site

It is best to calibrate in the EC range closest to that of your waterway. If more than one site is monitored and they are very different in EC (e.g. surface water and groundwater or freshwater stream and estuary), calibrate for each site.

Calibrating the ECScan low/high range meter

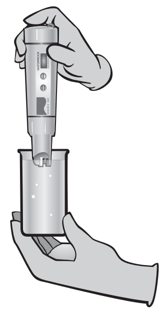
Procedure

1. Unscrew the top of the meter (battery compartment) and identify the white buttons (INC and DEC buttons).



2. Orientate the battery compartment as shown in the diagram.

3. Turn the meter on (by pressing the ON/OFF button).



4. Dip the electrodes into the standard calibration solution and swirl the container, meter and solution.

5. Wait several seconds until the number stabilises.

6. Press the INC or DEC key (see diagram above) to adjust the reading to match the calibration standard value.

7. After 3 seconds without pressing any buttons the display will flash 3 times then show 'ENT'.

8. Turn off the meter. Blow dry the meter and replace the cap.

The meter is now calibrated.

i **Testing tip:** **Discard the calibration solution after use. Never return it to the container.**

ECTestr 11 and 11+

The ECTestr 11 and 11+ meters are dual range meters that permit the measurement of both high and low levels of salinity.

The meter uses different measurement units, depending on the salinity of the sample.

Selecting your measuring range

Selection	To be used when measuring water between:	Measuring range	Resolution
HI	2000 µS/cm and 20,000 µS/cm only	0–20 mS/cm (20,000 µS/cm)	0.1 mS/cm (100 µS/cm)
LO	0 and 2000 µS/cm only	0–2000 µS/cm	10 µS/cm
AUTO	0 and 20,000 µS/cm or 0 and 20 mS/cm	0–2000 µS/cm 0–20 mS/cm (20,000 µS/cm)	10 µS/cm (low) 0.1 mS/cm (100 µS/cm) (high)

How to select a measuring range

1. Ensure the meter is switched off.

2. Hold the °C/°F button and then switch the meter on by pressing the ON/OFF button. Release the °C/°F button once the meter is turned on.

3. Select either HI, LO or AUTO by pressing the HOLD/ENT key to switch between each measuring range.

4. Once the correct range appears on the screen do not press again (if nothing is pressed for 5 seconds the meter will confirm the selection by displaying 'CO' and will then go into measurement mode).

The range does not need to be set again unless you wish to change the range.

Calibration of ECTestr 11 and 11+ meters

The dual range EC meter has automatic calibration. In most cases you will not need to calibrate the meter manually if a standard calibration solution is used. The meter will calibrate automatically.

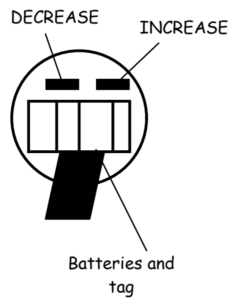
Meters should be calibrated across the entire measuring range over which they will be used. If meters are used in **both** high and low ranges, you will need to calibrate **both** ranges (i.e. multi-point calibration). If you are using the meter in a single range, calibrate using the appropriate standard solution for that range (single point calibration). The following is a guide:

- HI – use single point calibration
- LO – use single point calibration
- AUTO – use multi-point calibration.

Standard solutions

Selected measuring range	Calibration standard
0–200 µS/cm	500 µS/cm
Low Range 0–2000 µS/cm	1413 µS/cm
High Range 0–20 mS/cm	12.88 mS/cm
AUTO	500 µS/cm; 1413 µS/cm; 12.88 mS/cm

How to change between single and multi-point calibration

Procedure	Instructions on screen
1. Unscrew the top of the meter (battery compartment) and identify the white keys.	
2. Hold down one of the buttons on the right hand side, while pressing the ON/OFF button.	Press ON/OFF AND Press one of the white buttons (INC/DEC key) at the same time
3. The display will show 'A.CAL', and will flash 'YES'. Press the °C/°F button to skip.	YES A.CAL
4. The display will then show '1.Pnt', and will flash 'YES' or 'NO'. Use either button under the cap to toggle between 'YES' and 'NO' and then press HOLD/ENT to make a selection. (Choose 'YES' if measuring in high or low range, and choose 'NO' if measuring in dual range.)	1.Pnt YES NO

Calibrating the ECTestr 11 and 11+

Single point calibration (AUTO)

A standard solution appropriate to the range of measurement **must** be used.

1. Screw off the top cover and remove the protective cap from the bottom.

2. Press the ON/OFF button to turn the meter on.

3. Press either button under the top cover to enter calibration mode.

4. Dip the electrodes into the standard calibration solution and swirl the container, meter and solution.

5. Wait until the top number stabilises. (This is what the meter is reading **before** calibration.)

6. Press HOLD/ENT. The meter will adjust to match the calibration standard value.

7. The meter shows 'CO' for 2 seconds and calibration is complete.

8. The upper display shows the conductivity reading and the lower display shows calibration standard values (see meter specifications on p. 2–8) in 'AUTO'.

9. Rinse the probes in deionised water.

10. The meter is now calibrated in a single range (high or low).

11. The meter will then enter measurement mode.

Multi-point calibration (AUTO)

1. Screw off the top cover and remove the protective cap from the bottom.

2. Press the ON/OFF button to turn the meter on.

3. Press either button that was under the top cover.

4. Pour **1413 µS/cm** calibration solution over the electrode.

5. Immerse the electrode in **1413 µS/cm** calibration solution.

6. Wait until the top number stabilises. (This is what the meter is reading **before** calibration.)

7. Press the HOLD/ENT button.

8. Pour deionised water over the electrode.

9. Pour **12.88 mS/cm** calibration solution over the electrode.

10. Immerse the electrode in **12.88 mS/cm** calibration solution.

11. Wait until the top number stabilises. (This is what the meter is reading **before** calibration.)

12. Press the HOLD/ENT button.

13. The meter will then enter measurement mode.

i **Testing tip:** **Discard the calibration solution after use. Never return it to the container.**

How to change from AUTO to a manual calibration

Use this method if you **do not** have a standard solution.

Procedure	Instructions on screen
1. Unscrew the top of the meter (battery compartment).	
3. Turn the meter on while holding the INC key at the same time (left key when screen is facing you). The display will appear as 'YES' 'A.CAL'.	YES A.CAL
4. Press the INC or DEC button to change to 'NO'. This will allow you to set up manual calibration.	NO
5. Press HOLD/ENT to select.	CO

Manual calibration

1. Press the ON/OFF button to turn the meter on.

2. Press either button under the top cover to enter calibration mode.

3. Dip the electrodes into the non-standard calibration solution and swirl the container, meter and solution.

4. Wait until the top number stabilises. If the reading does not match the calibration standard you are using, press the top white buttons to change the reading up or down, until the number matches your calibration solution.

5. Leave the probes in the calibration solution and do not touch any buttons for 5 seconds.

6. The meter shows 'CO' for 2 seconds and calibration is complete.

7. The meter is now calibrated.

> **Testing tip:** **Discard the calibration solution after use. Never return it to the container.**

Note: If you are using the same calibration liquid each time you calibrate, you do not need to repeat steps 1–7 each time you calibrate.

Error messages

During calibration, if the error message 'Er.0' appears the calibration liquid is too hot or cold. Calibration liquid should be stored in the fridge but used at **room temperature**.

During calibration, if the error message 'Er.1' appears you have pressed the HOLD/ENT key before the tester has recognised the calibration standard.

> **Equipment tip:** **To return your meter to the factory default settings press HOLD/ENT and switch on the tester using the ON/OFF key. Release the HOLD/ENT key.**

SECTION 3

Testing water quality in the field

The water quality tests included in the Junior Waterwatch program will allow students to measure and understand important catchment issues. Students will learn about key water quality issues and the interaction between what happens on nearby land and the health of their waterway. The tests are simple, safe and fun for primary school students.

This section provides information on how to ensure that the data collected by students is of the highest quality, plus methods for preserving samples and diluting them if needed.

Included in this section: *Page*

i **Background information about the water quality tests is provided in the *Junior Waterwatch Teachers' Guide*.**

3.1 Collecting quality data

Follow these tips to ensure the data you collect is of the highest quality.

Keep your equipment clean	Poorly cleaned equipment can lead to inaccurate results. Refer to Sections 2 and 4 for specific instructions on cleaning and maintenance of equipment.
Follow the testing instructions closely	You are using scientific testing equipment. Following the procedures carefully will ensure the most accurate results.
Collecting your sample	Collect samples according to the instructions. Temperature should be tested at the waterway.
Record in the right units	Each test uses different measurement units. It is important that results are reported using the correct units. Some measures, such as electrical conductivity as a measure of salinity, require conversion.
Recording at the site	Record your results on the forms provided. This will ensure that all necessary information is recorded at the site. Never use scraps of paper.
Calibration	Some meters require calibration to ensure they continue to record accurately, e.g. EC meters. Follow the instructions provided and calibrate prior to use.
Change the batteries	Equipment using batteries needs regular checking because low batteries can affect readings. Make sure you renew batteries at the recommended intervals.

Units of measure

Parameter	Unit of measurement
Temperature	degrees Celsius (°C)
pH	pH units
Electrical conductivity (EC)	microsiemens per centimetre (μS/cm) OR millisiemens per centimetre (mS/cm)
Turbidity	nephelometric turbidity units (NTU)
Rate of flow	metres/second

i **More information about collecting quality data, including quality assurance and quality controls (QA/QC), is provided in Section 5.3.**

3.2 Preserving samples

If you cannot do all the tests when the water sample is taken, some can be done later if samples are properly preserved.

Follow these guidelines for preserving samples:

Parameter	Preservation method	Maximum holding time	Comments
pH	Refrigeration	6 hours	Completely fill sample bottle and test as soon as possible
Conductivity	Refrigeration	30 days	Completely fill sample bottle
Turbidity	None required	24 hours	Preferably test on site

Source: *Waterwatch Technical Manual*, Module 4, Physical and Chemical Parameters, p.5.

3.3 Measuring high salinity levels by diluting samples

When measuring salinity, some samples may exceed the limit of the available meter. An error message 'OR' will appear in the screen (over range). The sample will need to be diluted for your meter to measure the salinity.

Choose a dilution factor that will allow your meter to measure the result. For estuarine water, a 1:5 dilution factor is recommended. For example, at 1:5 dilution: original sample = 10 mL, sample after dilution = 50 mL.

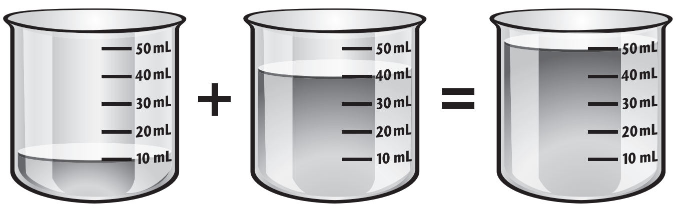
> *i* **Measurement tip: A 1:5 solution is 1 part sample water and 4 parts deionised water.**

Instructions follow for diluting samples for use with either a TDS meter or a high range EC meter.

Diluting a sample for measurement of electrical conductivity (EC meter)

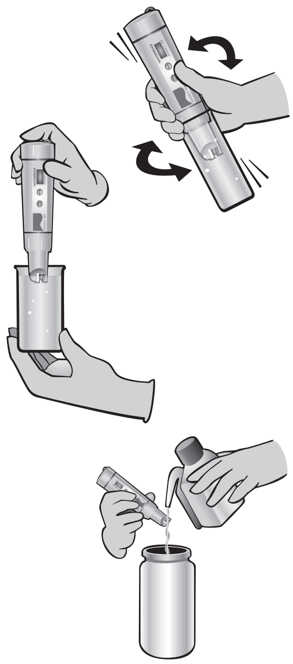
It is recommended that a high range EC meter is used when the salinity level is high.

1. Pour 10 mL of the sample into the 50 mL specimen tube or measuring cylinder and add deionised water to make up to 50 mL.



> *i* **Testing tip: Using larger volumes of water (e.g. 20 mL sample water and 80 mL of deionised water) may reduce error caused by dilution.**

2. Rotate to mix thoroughly.



3. Pour the diluted sample into a clean specimen tube and mix thoroughly again by rotating.

4. Carry out the test using the EC meter.

5. Rinse the probes of the meter with deionised water and cap them.

6. Return the meter to the kit.

7. Calculate the result by multiplying the meter reading by the dilution factor of 5.

> *i* **Measurement tip:** **EC meter reading x 5 = EC result**

8. Convert the result from millisiemens per centimetre (mS/cm)/microsiemens per centimetre (µS/cm) (for high range EC meters).

9. Record the result in the table on the result sheet.

Calculating the EC of the original sample

If the result is given in microsiemens per centimetre (µS/cm), multiply your result by the dilution factor (e.g. x5 for the above procedure).

Example 1: Diluting samples measured in microsiemens per centimetre (µS/cm)

Salinity result for diluted water sample = 600 µS/cm

Salinity of diluted water sample x dilution factor =
600 µS/cm x 5 = 3000 µS/cm

Salinity of original water sample = 3000 µS/cm

Number on screen	Dilution factor x5	EC µS/cm
600	5	3000

If the result is given in millisiemens per centimetre (mS/cm), multiply your result by the dilution factor, then multiply by 1000 to return the result to microsiemens per centimetre (µS/cm).

Example 2: Diluting samples measured in millisiemens per centimetre (mS/cm) to microsiemens per centimetre (µS/cm)

Salinity of diluted water sample = 5.30 mS/cm

Salinity of diluted water sample x dilution factor =
5.30 mS/cm x 5 = 26.5 mS/cm

Salinity of original water sample = 26.5 mS/cm x 1000
(convert mS/cm to µS/cm)

Salinity of original water sample = 26,500 µS/cm

Number on screen	Dilution factor x5	EC mS/cm	Convert to µS/cm x1000	EC µS/cm
5.3	5	26.5	1000	26,500

i **Measurement tip:** **The dilution factor will depend on the salinity of the sample water and the type of meter you are operating. Low range meters measure in microsiemens per centimetre (µS/cm) and high range meters in millisiemens per centimetre (mS/cm). Remember to notice if the result has a decimal point and is given in mS/cm or as a whole number (µS/cm). Make sure you multiply the on-screen display by the dilution factor.**

SECTION 4

Student procedure sheets

The water quality tests included in the Junior Waterwatch program will allow students to measure and understand important catchment issues. Students will learn about key water quality issues and the interaction between what happens on nearby land and the health of their waterway. The tests are simple, safe and fun for primary school students.

This section provides detailed procedure sheets for use on site, including how to collect a water sample and how to do each kind of test on it.

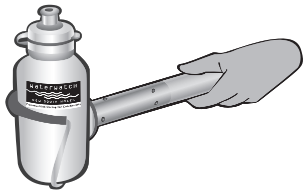
Included in this section:

Note: **Background information about the water quality tests is provided in the *Junior Waterwatch Teachers' Guide*.**

4.1 Collecting a surface water sample

Procedure

Equipment: Long arm sampler, snap adaptor and water sample bottle.



1. Use a long arm sampler so the water sample is collected away from the edge of the bank.

2. Rinse the collection bottle three times with water from downstream of the test site, i.e. with water from the same area. Empty rinse water onto the bank or away from the water source to avoid stirring up the water you are about to test.

3. Extend the pole with the sample bottle in place. Make sure the pole is not too long and difficult to handle.

4. Have a buddy hold you while collecting the sample.

5. Turn the bottle top down over the water and submerge it about 20 cm or to elbow depth if possible. In shallow water make sure you do not disturb the stream bed as this may discharge sediments that will contaminate your sample.

6. Once the bottle is under the water, turn it sideways, pointing upstream (into the direction of flow) and allow it to fill.

7. Turn the bottle upright and quickly bring it up out of the water to avoid surface scum contaminating the sample.

8. Use the same sample for all tests conducted at the site.

> *i* **Safety tip:** **To avoid electrocution never carry or lift the pole above your head! Always carry the extension pole horizontally and below shoulder level. This applies both on the way to the site and at the site.**

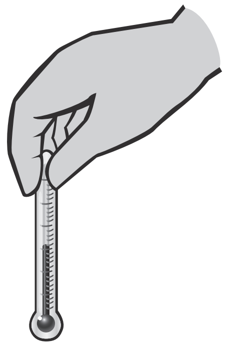
4.2 Measuring temperature

What is temperature?

Temperature is a measure of heat and cold.
It is measured in degrees Celsius (°C).

Procedure

Equipment: thermometer, water sample bottle (optional).



Air Temperature

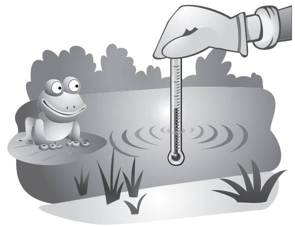
1. Measure the temperature in the shade, by holding the thermometer at waist height, by the top of the thermometer and in the shade of your body – or find a shaded place.

2. Wait for at least one minute before reading the thermometer.

3. Ask another person (if possible) to confirm your result.

4. Record your results for Air Temperature.

Water Temperature



1. Lower the thermometer into the water (in the creek or in a freshly collected sample).

2. Keep the thermometer in the water for 1 minute before taking the temperature reading.

3. Read the thermometer while it is still in the water.

4. Repeat the test with a different student reading the thermometer to verify the results.

5. Rinse the thermometer with deionised water and put it back into the kit.

6. Record your result.

> *i* **Safety tip: Work with a buddy to test temperature.**

What do the results mean?

Temperature

There are no trigger values for temperature to apply a healthy or poor rating. The acceptable temperature range will depend specifically on your site, and any nearby features, such as large dams.

4.3 Measuring pH

What is pH?

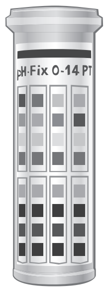
pH is a measure of acidity and alkalinity measured on a scale of 0–14.

Procedure

Equipment: **pH papers, small container.**

1. Take the water sample you collected in Procedure 4.1.

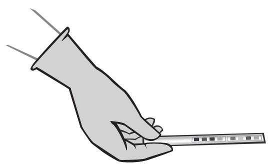
2. Shake the sample.



3. Rinse out a small container with sample water 3 times.

4. Fill the container with sample water or test directly from the sample bottle.

5. Take a pH strip and dip all the coloured squares into the sample water. Make sure all colours are underwater.



6. Leave the strip in the water for 5 minutes.

7. Remove the strip and match its colours against the colour chart to work out your pH.

8. If you cannot match the colours exactly you can estimate between two colours to 0.5 of a pH unit.

9. Pass the strip to others to verify the result.

10. Dispose of the pH strip in the bin.

11. Record your result.

What do the results mean?

pH

← Neutral →

0	Acid	7	Alkaline	14

<6.5 poor

6.5–8 healthy

>8 poor

Note: Sudden changes in pH are undesirable and may cause a loss of native plants and animals.

4.4 Measuring total dissolved solids

Make sure you use the procedure sheet that corresponds to the type of meter you have.

What is total dissolved solids (TDS)?

TDS is a measure of salinity. The TDS meter measures electrical conductivity (EC) and converts this measurement to an amount of salt in parts per million (ppm) or milligrams per litre (mg/L). The more salt in the water, the greater the electrical current that will be transferred and the higher the TDS reading.

Procedure to measure total dissolved solids

Equipment: TDS meter, sample water specimen container, calibration liquid, deionised water.

1. Take the water sample you collected in Procedure 4.1.

2. Rinse out a small container with sample water at least twice.

3. Shake the water sample and pour some into the specimen container to a depth of about 3 centimetres.

4. Remove the cap from the meter and turn it on. Wait until a 0 appears.

i **Equipment tip:** Remember to calibrate your meter before testing!

5. Dip the meter into the specimen container of sample water so the probes are covered.

> *i* **Equipment tip: Do not put the meter deeper than the immersion line marked on the base.**
> **Do not rest the probes on the base of the container.**

6. Hold the meter in the sample water and rotate your wrist so that the sample water, container and meter move. Allow time for the number value to display and stabilise.

7. Read the TDS from the meter screen.

8. Identify the unit of measurement the meter is reading: parts per million (ppm) for the lower range (low salinity) or parts per thousand (ppt) for the higher range (high salinity).

9. Repeat the test to verify the result.

10. Turn the meter off and rinse the probes with deionised water.

11. Do not wipe the meter probes – blow on them or allow to air dry.

12. Replace the cap on the meter and put it back in the kit.

13. Record your result.

> *i* **Measurement tip: Enter your TDS result as mg/L = ppm.**

What do the results mean?

Total dissolved solids (TDS)

Healthy

Less than 200 mg/L

Fair – may affect river health

200–500 mg/L

Poor – river health at risk

Greater than 500 mg/L

Note: Average for all waterways; not specific to position in the catchment.
Adapted from *ANZECC Guidelines 2000*

4.5 Measuring electrical conductivity: low and high range meters

Make sure you use the procedure sheet that corresponds to the type of meter you have.

What is electrical conductivity?

Electrical conductivity (EC) is the amount of transfer of electricity through water and is a measure of salinity. The more salt in the water, the greater the electrical current that will be transferred and the higher the EC.

Procedure to measure salinity: low and high range meters

For detailed instructions on setting up these meters, refer to Section 2.4.

Equipment: Electrical conductivity (EC) meter (low or high range), small container, sample water, calibration liquid, deionised water.

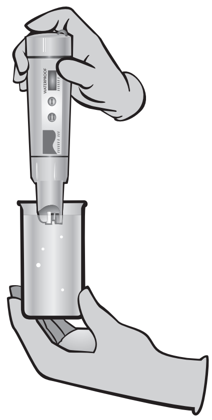
1. Collect a water sample from the waterway.

2. Rinse out a small container with sample water at least twice.

3. Shake the water sample and pour some into the specimen container to a depth of about 3 centimetres.

4. Remove the cap from the meter and turn it on. Wait until a '00' appears.

> **Equipment tip: Remember to calibrate your meter before testing!**



5. Dip the meter into the small container of sample water so the probes are covered.

> **Equipment tip: Do not put the meter deeper than the immersion line indicated by the shape of the base. Do not rest the probes on the base of the container.**

6. Hold the meter in the sample water and rotate your wrist so that the sample water, container and meter move. Allow time for the number value to display and stabilise.

7. Read the EC from the meter screen.

8. Identify the unit of measurement the meter is reading (µS/cm or mS/m).

9. Repeat the test to verify the result.

10. Turn the meter off and rinse the probes with deionised water.

11. Do not wipe the meter probes – blow on them or allow to air dry.

12. Replace the cap on the meter and put it back in the kit.

13. Record your result.

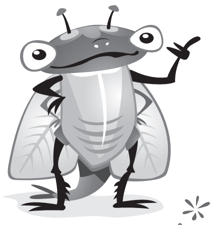
> *i* **Measurement tip:** **Low range meters measure in μS/cm. High range meters measure in mS/cm = dS/m. Multiply the on-screen display by 1000 to convert to μS/cm.**

What do the results mean?

Electrical conductivity (EC)

Salinity is measured by electrical conductivity (EC). Increases in salinity can affect freshwater ecosystems.

Healthy



Less than 300 μS/cm

Less than 0.3 mS/cm

Fair – may affect river health

300 to 800 μS/cm

0.3 to 0.8 mS/cm

Poor – river health at risk

Greater than 800 μS/cm

Greater than 0.8 mS/cm

Note: Average for all waterways; not specific to position in the catchment.
Adapted from *ANZECC Guidelines 2000*

4.6 Measuring electrical conductivity: dual range meters

Make sure you use the procedure sheet that corresponds to the type of meter you have.

What is electrical conductivity?

Electrical conductivity (EC) is the amount of transfer of electricity through water and is a measure of salinity. The more salt in the water, the greater the electrical current that will be transferred and the higher the EC.

Procedure to measure salinity: dual range meter (EC11 & EC11+)

For detailed instructions on setting up this meter, refer to Section 2.4.

Equipment: Electrical conductivity (EC) meter (dual range), small container, sample water, calibration liquid, deionised water.

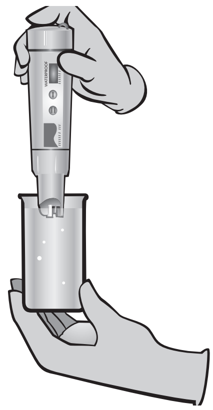
1. Collect a water sample from the waterway.

2. Rinse out a small container with sample water at least twice.

3. Shake the water sample and pour some into the specimen container to a depth of around 3 centimetres.

4. Remove the cap from the meter and turn it on. Wait until a ‘0’ appears.

> *i* **Equipment tip:** Remember to calibrate your meter before testing!



5. Dip the meter into the small container of sample water so the probes are covered.

> *i* **Testing tip:** Do not put the meter deeper than the immersion line marked on the base.
> Do not rest the probes on the base of the container.

6. Hold the meter in the sample water and rotate your wrist so that the sample water, container and meter move. Allow time for the number value to display and stabilise. (The HOLD button can be pressed, so that a measurement can be read after taking the probe out of the solution.)

7. Read the EC from the meter screen.

8. For dual range meters, record the upper number as EC, noting whether it is µS/cm or mS/cm. Record the lower number as temperature.

> *i* **Measurement tip:** mS/cm = dS/m = 1000 µS/cm

9. Repeat the test to verify the result.

10. Turn the meter off and rinse the probes with deionised water.

11. Do not wipe the meter probes – blow on them or allow to air dry.

12. Replace the cap on the meter and put it back in the kit.

13. Record your result in microsiemens per centimetre (µS/cm).

What do the results mean?

Electrical conductivity (EC)

Salinity is measured by electrical conductivity (EC). Increases in salinity can affect freshwater ecosystems.

Healthy

Less than 300 µS/cm

Less than 0.3 mS/cm

Fair – may affect river health

300 to 800 µS/cm

0.3 to 0.8 mS/cm

Poor – river health at risk

Greater than 800 µS/cm

Greater than 0.8 mS/cm

Note: Average for all waterways; not specific to position in the catchment.
Adapted from *ANZECC Guidelines 2000*

4.7 Measuring turbidity

What is turbidity?

Turbidity measures the muddiness or cloudiness of the water. Suspended material such as clay, silt, sand or algae can increase the turbidity of water, affecting biodiversity, plant growth and other water uses.

Procedure

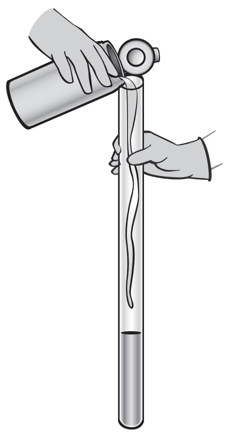
Equipment: Turbidity tube, sample water.

1. Assemble the turbidity tube by sliding the two pieces together.

i **Testing tip: The turbidity test should be conducted in the shade.**

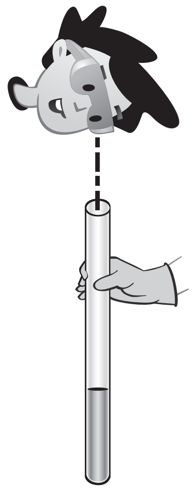
2. One person holds the joined tube upright on the ground ready for pouring.

3. The other person shakes the water sample in the sample bottle and slowly pours it into the tube. Pour a little at a time and look down into the tube.



4. Stop pouring when the three distinct black lines at the bottom of the tube cannot be seen clearly (you may need to wait for the water to stop swirling to see whether the lines can be observed clearly).

5. Measure the turbidity by recording the last marked point **below** the level of the water. Do not estimate between the lines.



> *i* **Measurement tip:** If you can still see the black lines when the water reaches the top of the tube, record the result as 7 NTU.

6. Check the result by swapping places and repeating the test.

7. Rinse the tube and place it back in the kit.

8. Record you result.

> *i* **Measurement tip:** The turbidity tube has a non-linear scale so readings **cannot** be estimated between two numbers. Read the number immediately below the water level, e.g. correct reading is 15 when the water level is between 10 and 15.

What do the results mean?

Turbidity

Increases in turbidity may cause a loss of plant and animal species.

Healthy
7 to 10 NTU

Fair – may affect river health
Greater than 10 to 30 NTU

Poor – river health at risk
Greater than 30 NTU

Note: Average for all waterways; not specific to position in the catchment.
Adapted from *ANZECC Guidelines 2000*

4.8 Measuring rate of flow

What is rate of flow?

The rate of flow is the speed or velocity of water movement. The flow of water can be a very important influence on the environment of your stream, affecting the oxygen levels, the concentration of pollutants or salinity, and other environmental needs of living things.

Procedure

Equipment: Stopwatch, stick or orange, tape measure.

1. Measure out 20 metres along the top of the streambank (two natural markers such as trees can be used).

....

2. From the upstream marker, throw a stick or orange into the water and start the stopwatch.

....

3. When the stick or orange reaches the second marker, stop the stopwatch.

....

4. Divide the distance by the time taken to calculate the flow.

....

5. Record your result.

Calculation of rate of flow

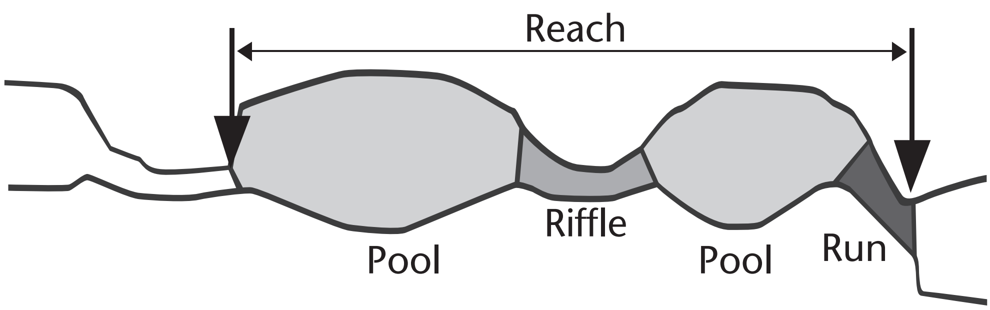
> **Measurement tip:** Rate of flow = $\frac{\text{distance}}{\text{time}}$

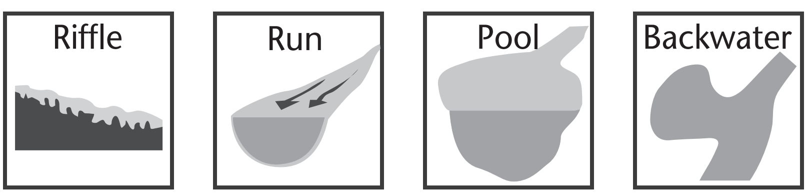
Rate of flow = distance/time, where distance is the distance between the start and finish points in metres (e.g. 20 metres) and time is the time taken for the stick to travel the distance in seconds. The unit of measurement for rate of flow is therefore metres per second (m/sec).

What do the results mean?

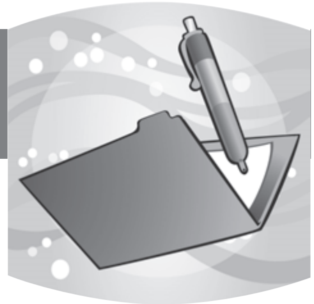
The rate of flow will change over time, and can be very different from one area to another. Knowing about rate of flow can help us understand what is going on in a waterway.

Note: The above method gives only an indication of the flow speed. Accurate measurement of flow involves more specialised equipment. Measuring flow volume requires a calculation of flow rate and stream cross-sectional area.





SECTION 5



Interpreting your results

The Australian and New Zealand Environment Conservation Council (ANZECC) has developed guidelines for classifying the quality of water in rivers, lakes, estuaries and marine waters. Waterwatch has also developed guidelines for linking water quality parameters to the health of ecosystems.

Students can apply the ANZECC and Waterwatch guidelines to the results of the water quality tests they conduct at their site and come up with an assessment of the health of their catchment. In doing so they will learn about the concept of trigger values and how they can help identify potential environmental problems.

Recording and interpreting the results of your water quality tests is made easy with the recording sheets provided. Careful use of these recording sheets will guarantee that all the information is recorded at the site and is ready to upload to the Waterwatch online database.

Included in this section: *Page*

5.1 ANZECC water quality guidelines

In 2000, the Australian and New Zealand Environment Conservation Council (ANZECC) released its water quality guidelines for rivers, lakes, estuaries and marine waters. It is important to know the height above sea level of your location so that your waterway can be classified according to the ANZECC guidelines.

> **Measurement tip:**
> **Upland stream: above 150 metres above sea level**
> **Lowland stream or coastal stream:**
> **below 150 metres above sea level**
> **Estuary/marine**

Water quality stressors

Changes in water quality may put pressure on an ecosystem. They may be due to either increases or decreases in the various water quality parameters. For example, an increase in salinity (EC or TDS) may cause stress on an ecosystem while any change in temperature may affect the same ecosystem. Such changes are called water quality stressors.

Water quality guidelines

A water quality guideline is a recommended value or range for a given parameter. Water quality guidelines help to identify when changes in a water quality parameter have the potential to cause an environmental problem. A significant departure from a guideline may trigger further investigation and thus is called a trigger value.

Waterwatch groups collect data at sites that may not be monitored by any other group or organisation. This information helps to develop guidelines for water quality and trigger values at their site.

The 2000 ANZECC guidelines (water quality) identified trigger values for water quality based on the location within a catchment.

Trigger value guidelines can:

- provide information that helps to identify potential environmental problems
- assist with management of key environmental issues
- assess the impact of management actions.

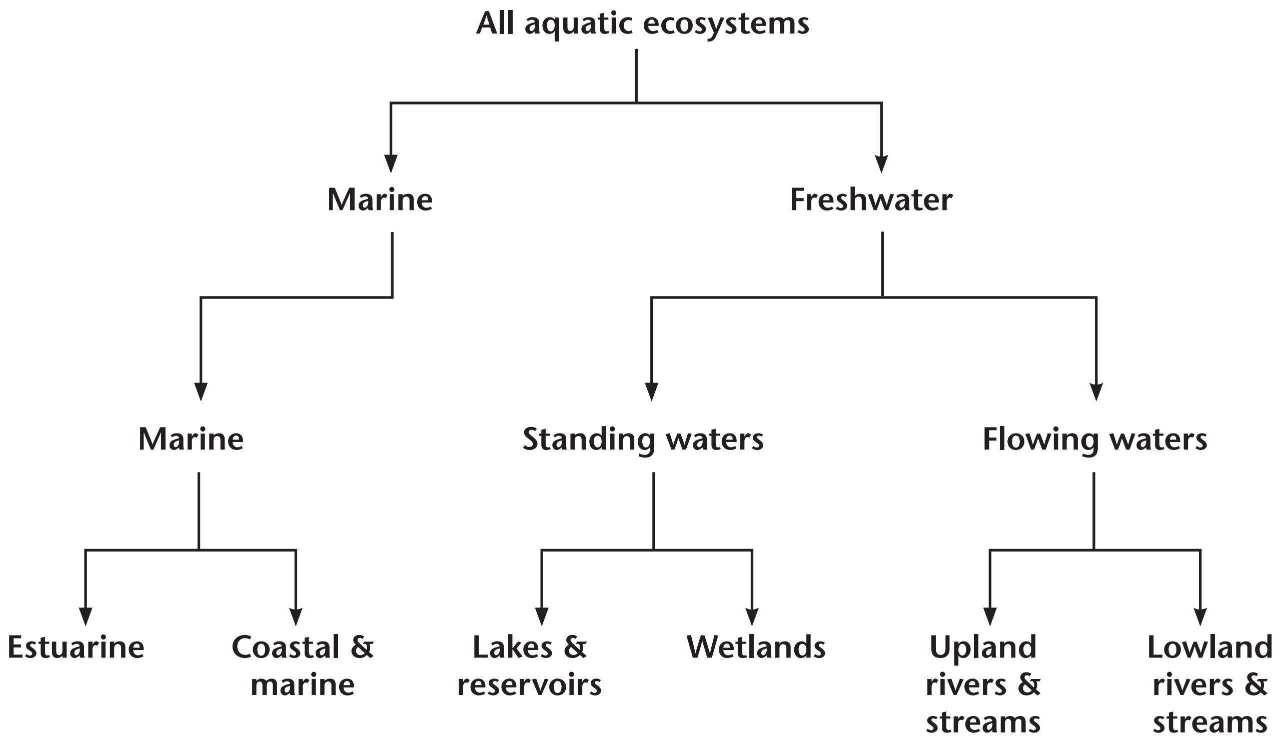
Summary of trigger values

	Uplands	**Lowlands**	**Lakes**	**Estuaries**
Temperature °C	N/A	N/A	N/A	N/A
pH	6.5–8.0	6.5–8.5	6.5–8.0	7.0–8.5
EC µS/cm	350 (0.35 mS/cm)	200–300 (0.2–0.3 mS/cm)	200–300 (0.2–0.3 mS/cm)	N/A
Turbidity NTU	25	50	20	10

Adapted from *ANZECC Guidelines 2000*

Water quality guidelines and aquatic ecosystems

There are different types of aquatic ecosystems.
These include:



Adapted from *ANZECC Guidelines 2000*

5.2 Waterwatch water quality assessment guidelines

Waterwatch provides an assessment of water quality for each parameter at your site, and also relates this to the health of the ecosystem.

Water quality	Ecosystem
Healthy	Healthy ecosystem – plants and animals adapted to natural environmental conditions
Fair	May affect river health – plants and animals at the site
Poor	Ecosystem at risk – aquatic plants and animals at risk

Summary of water quality within catchments

Upland rivers	Healthy	Fair	Poor
Turbidity	Less than 10 NTU	10–25 NTU	Greater than 25 NTU
Electrical conductivity	Less than 350 µS/cm	350–800 µS/cm	Greater than 800 µS/cm
pH	6.5–8.0	N/A	Less than 6.5 (acid) or greater than 8.0 (alkaline)
Lowland rivers	**Healthy**	**Fair**	**Poor**
Turbidity	Less than 10 NTU	10–50 NTU	Greater than 50 NTU
Electrical conductivity	Less than 300 µS/cm	300–800 µS/cm	Greater than 800 µS/cm
pH	6.5–8.5	N/A	Less than 6.5 (acid) or greater than 8.5 (alkaline)

Lakes and dams	Healthy	Fair	Poor
Turbidity	Less than 20 NTU	20–50 NTU	Greater than 50 NTU
Electrical conductivity	Less than 300 µS/cm	300–800 µS/cm	Greater than 800 µS/cm
pH	6.5–8.0	N/A	Less than 6.5 (acid) or greater than 8.0 (alkaline)
Estuary	**Healthy**	**Fair**	**Poor**
Turbidity	Less than 10 NTU	10–30 NTU	Greater than 30 NTU
Electrical conductivity	N/A	N/A	N/A
pH	7.0–8.5	N/A	Less than 7.0 or greater than 8.5

5.3 Collecting and recording quality data

Quality assurance

Quality assurance means that the data collected is accurate and reliable because a consistent standard has been used when collecting and testing water samples. Waterwatch has quality assurance and quality controls (QA/QC) incorporated into the program. This ensures confidence in the data gathered within the program.

The following checklist will help your group produce high quality data:

✓ Use only approved Waterwatch equipment.

✓ Training is required to master the testing skills and to learn about important occupational health and safety issues.

✓ Take care of equipment – always store in a cool, dry place and clean regularly.

✓ Calibrate your EC meter before use.

✓ Be involved in quality assurance/quality control events held in your area.

Recording sheets

The remaining pages in this section are recording sheets to help students record and interpret the results of their water quality testing activities correctly.

Make sure you are using the appropriate recording sheet for the location of your site within the catchment. Different sheets are provided for:

- upland rivers
- lowland rivers
- lakes and dams
- coasts and estuaries.

Uploading data to the Waterwatch online database

Your Waterwatch Coordinator will provide information about how to upload the data you collect to the Waterwatch online database. You will need a username and password to enter data.

5.4 Summary water quality results: lakes and dams (EC meters)

Field results sheet: lakes & dams

Site name: ....

Date: ....

Catchment: ....

Location in catchment: ....

Observations at the site: ....

....

....

....

....

....

Record your results as soon as possible after testing: www.waterwatch.nsw.gov.au

Water quality trigger values

The point where a change in water quality affects river health.

	Temp. °C*	**pH** Increase or decrease may affect waterway health	**EC** Increase may affect waterway health	**Turbidity** Increase may affect waterway health
Value	N/A	6.5–8.0	300 µS/cm 0.30 mS/cm	20 NTUs

* Guidelines apply only to human exposure.
Source: *ANZECC Guidelines 2000*

Notes:

Temperature

Results: Water Temp. .... °C   Air Temp. .... °C

No set trigger value. Animals and plants in and around aquatic ecosystems are adapted to living within a particular temperature range to maintain their survival and provide reproduction cues. Taking note of 'normal' temperature conditions at this site will allow you to determine whether an increase or decrease in temperature might be harmful to this ecosystem.

Note: High water temperatures can increase algal growth in dams.

pH

Results: ....

An increase or decrease in pH may cause a loss of native plants and animals.

Tick the boxes below that relate to your result:

← Neutral →

1	Acid	7	Alkaline	14

My result is: ☐ Acid ☐ Neutral ☐ Alkaline

Healthy

☐ 6.5 to 8.0

Poor: plants and animals at risk

☐ <6.5 or >8.0

Salinity

Results: .... mS/cm X 1000 = ... µS/cm

Salinity is measured by its electrical conductivity (EC).

Tick the box below that relates to your result:

Healthy

☐ Less than 300 µS/cm
Less than 0.3 mS/cm

Fair: may affect plants and animals

☐ 300–800 µS/cm
0.3–0.8 mS/cm

Poor: plants and animals at risk

☐ Greater than 800 µS/cm
Greater than 0.8 mS/cm

Turbidity

Results: .... NTU

Increases in turbidity may cause a loss of native plants and animals.

Tick the box below that relates to your result:

Healthy

☐ Less than 10 NTU

Fair: may affect plants and animals

☐ 10 to 20 NTU

Poor: plants and animals at risk

☐ Greater than 20 NTU

5.5 Summary water quality results: lowland rivers (EC meters)

Field results sheet: lowland rivers

Site name: ....

Date: ....

Catchment: ....

Location in catchment: ....

Less than 150 metres above sea level.

Observations at the site: ....

....

....

....

....

Record your results as soon as possible after testing: www.waterwatch.nsw.gov.au

Water quality trigger values

The point where a change in water quality affects river health.

	Temp. °C*	**pH** Increase or decrease may affect waterway health	**EC** Increase may affect waterway health	**Turbidity** Increase may affect waterway health
Value	N/A	6.5–8.0	300 µS/cm 0.30 mS/cm	15 NTUs

* Guidelines apply only to human exposure.
Source: *ANZECC Guidelines 2000*

Notes:

Temperature

Results: Water Temp. .... °C Air Temp. .... °C

No set trigger value. Animals and plants in and around aquatic ecosystems are adapted to living within a particular temperature range to maintain their survival and provide reproduction cues. Taking note of 'normal' temperature conditions at this site will allow you to determine whether an increase or decrease in temperature might be harmful to this ecosystem.

Note: High water temperatures can increase algal growth in dams.

pH

Results: ....

An increase or decrease in pH may cause a loss of native plants and animals.

Tick the boxes below that relate to your result:

← Neutral →

1	Acid	7	Alkaline	14

My result is: ☐ Acid ☐ Neutral ☐ Alkaline

Healthy

☐ 6.5 to 8.0

Poor: plants and animals at risk

☐ <6.5 or >8.0

Salinity

Results: .... mS/cm X 1000 = ... µS/cm

Salinity is measured by its electrical conductivity (EC).

Tick the box below that relates to your result:

Healthy

☐ Less than 300 µS/cm
Less than 0.3 mS/cm

Fair: may affect plants and animals

☐ 300–800 µS/cm
0.3–0.8 mS/cm

Poor: plants and animals at risk

☐ Greater than 800 µS/cm
Greater than 0.8 mS/cm

Turbidity

Results: .... NTU

Increases in turbidity may cause a loss of native plants and animals.

Tick the box below that relates to your result:

Healthy

☐ Less than 15 NTU

Fair: may affect plants and animals

☐ 15 to 50 NTU

Poor: plants and animals at risk

☐ Greater than 50 NTU

5.6 Summary water quality results: upland rivers (EC meters)

Field results sheet: upland rivers

Site name: ....

Date: ....

Catchment: ....

Location in catchment: ....

More than 150 metres above sea level.

Observations at the site: ....

....

....

....

....

Record your results as soon as possible after testing:
www.waterwatch.nsw.gov.au

Water quality trigger values

The point where a change in water quality affects river health.

	Temp. °C*	**pH** Increase or decrease may affect waterway health	**EC** Increase may affect waterway health	**Turbidity** Increase may affect waterway health
Value	N/A	6.5–8.5	350 µS/cm 0.35 mS/cm	10 NTUs

* Guidelines apply only to human exposure.
Source: *ANZECC Guidelines 2000*

Notes:

Temperature

Results: Water Temp. .... °C Air Temp. .... °C

No set trigger value. Animals and plants in and around aquatic ecosystems are adapted to living within a particular temperature range to maintain their survival and provide reproduction cues. Taking note of 'normal' temperature conditions at this site will allow you to determine whether an increase or decrease in temperature might be harmful to this ecosystem.

Note: Cold, deoxygenated water released from dams can lack oxygen and affect plants and animals for many kilometres below the dam.

pH

Results: ....

An increase or decrease in pH may cause a loss of native plants and animals.

Tick the boxes below that relate to your result:

←		Neutral		→
1	**Acid**	**7**	**Alkaline**	**14**

My result is: ☐ Acid ☐ Neutral ☐ Alkaline

Healthy

☐ 6.5 to 8.0

Poor: plants and animals at risk

☐ <6.5 or >8.0

Salinity

Results: .... mS/cm X 1000 = ... µS/cm

Salinity is measured by its electrical conductivity (EC).

Tick the box below that relates to your result:

Healthy

☐ Less than 350 µS/cm
Less than 0.35 mS/cm

Fair: may affect plants and animals

☐ 350–800 µS/cm
0.35–0.8 mS/cm

Poor: plants and animals at risk

☐ Greater than 800 µS/cm
Greater than 0.8 mS/cm

Turbidity

Results: .... NTU

Increases in turbidity may cause a loss of native plants and animals.

Tick the box below that relates to your result:

Healthy

☐ Less than 10 NTU

Fair: may affect plants and animals

☐ 10 to 25 NTU

Poor: plants and animals at risk

☐ Greater than 25 NTU

SECTION 6

Habitat assessments

Land-based activities affect water quality and river health. Biological monitoring complements water quality monitoring and helps measure change, identify risks and plan management actions.

This section provides work sheets to assist students to conduct biological assessments of their site. Waterbird and water plant identification charts and observation sheets are also provided. These resources will increase students' understanding of the habitats associated with waterways and teach them essential skills for doing their own biological assessments.

Included in this section: *Page*

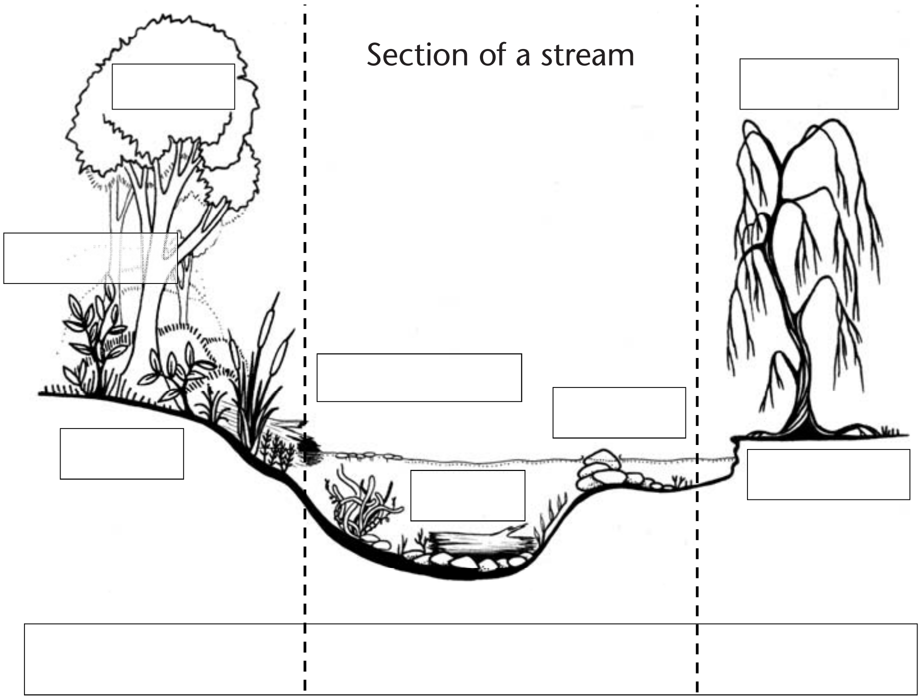
Note: **Background information for the habitat assessments is provided in the *Junior Waterwatch Teachers' Guide*. More student work sheets and some fact sheets are also available in the teachers' guide.**

6.1 Features of the riparian zone work sheet

Site name: ....

Date: ....

Label the features of the riparian zone on the diagram.

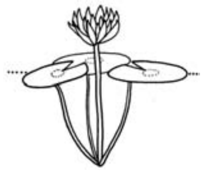


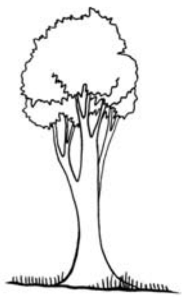
Look at the banks of your creek or river and tick what you can see:

Plants in the water: ☐ Floating ☐ Under the water ☐ On top of the water

Verge: ☐ Trees ☐ Shrubs ☐ Grasses

Banks: ☐ Trees ☐ Shrubs ☐ Grasses





A healthy river will have a variety of plants.

How many different types can you see?

Trees: .... Shrubs .... Grasses ....

How tall is the biggest tree? ....

Are there weeds at your site? ☐ Lots ☐ A few ☐ None

Can you name one? ....

6.2 The banks at your site work sheet

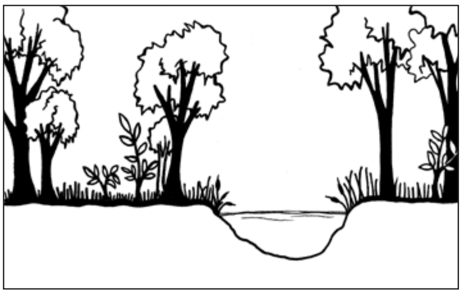
Site name: ....

Date: ....

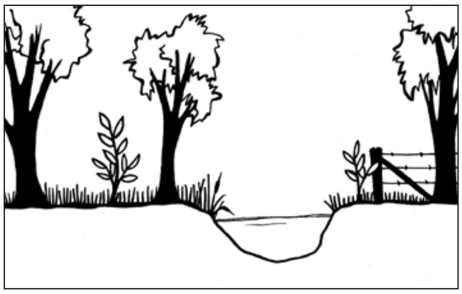
A healthy waterway has trees and plants on the bank and few weeds.

Tick the picture which most looks like the banks of your creek:

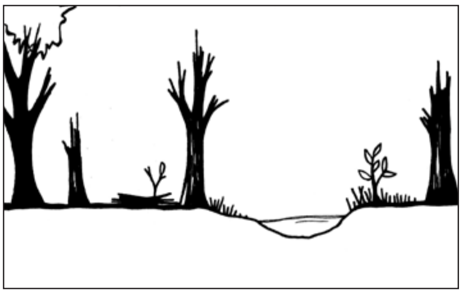
☐ **very good** – trees both sides, understorey



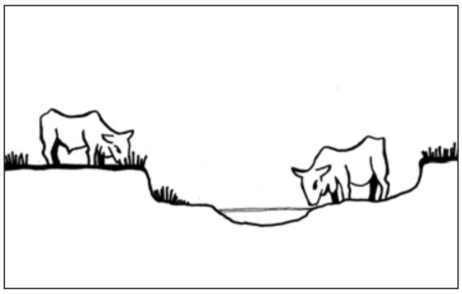
☐ **good** – trees and shrubs both sides, sparse



☐ **poor** – dead trees both sides, scattered, isolated



☐ **very poor** – nothing either side, cattle grazing on bank



Riparian vegetation:

☐ none ☐ little ☐ fair ☐ abundant

Types of vegetation:

☐ natives ☐ weeds/introduced plant species ☐ mixture of natives and weeds

Habitat for terrestrial fauna:

☐ none ☐ poor ☐ fair ☐ abundant

Habitat for aquatic fauna:

☐ none ☐ poor ☐ fair ☐ abundant

Impacts to fauna evident:

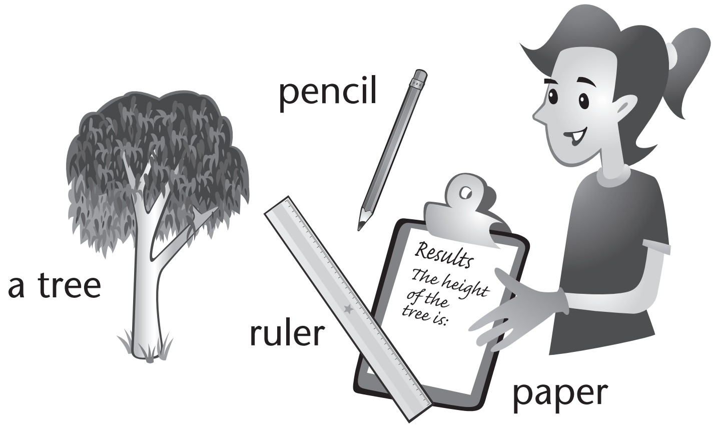
☐ pollution ☐ erosion ☐ vegetation clearing

6.3 How tall is that tree?

This field sheet will show you how to gain the essential skill of estimating the height of a tree.

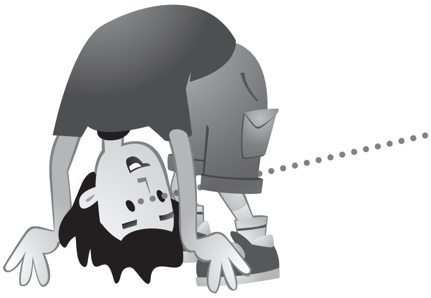
You will need:

- a tree to observe
- pencil
- ruler
- paper

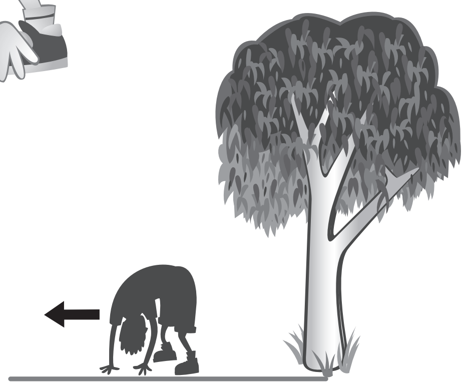


What to do:

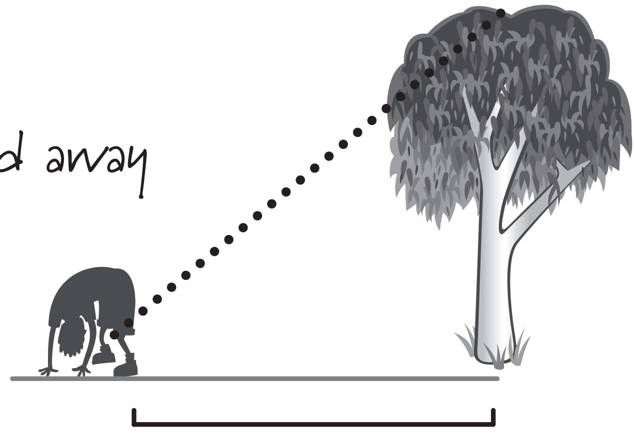
Bend over and look at the tree through your legs.



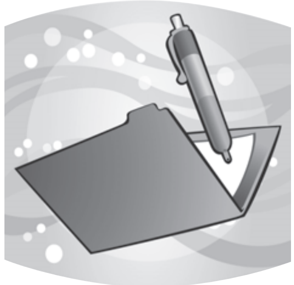
Move forward, away from the tree, until you can see the top of the tree.



The distance you have moved away is an estimate of how tall the tree is.



6.4 My favourite native tree work sheet



Site name: ....

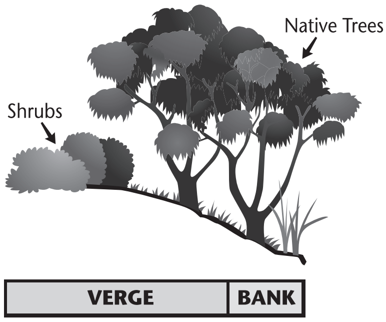
Date: ....

My favourite native tree is: ....

Tree ID: (photo or drawing)

My favourite tree is:

- ☐ on the bank
- ☐ on the verge



Height: ....
(Use the 'look between your legs' method described in Section 6.3 of the manual.)

Leaf colour: ....

Smell: ....
(bend the leaf and smell)

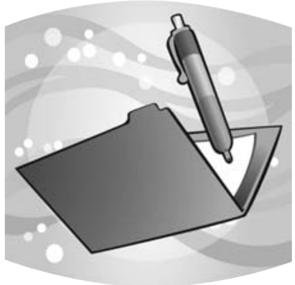
Seeds: ....

Flowers: ....

Bark rubbing

Leaf rubbing/drawing

6.5 Water plants at the site work sheet

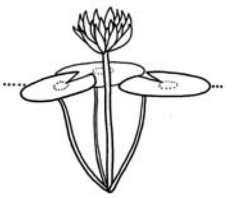


Site name: ....

Date: ....

Draw a big picture of a water plant you can see.

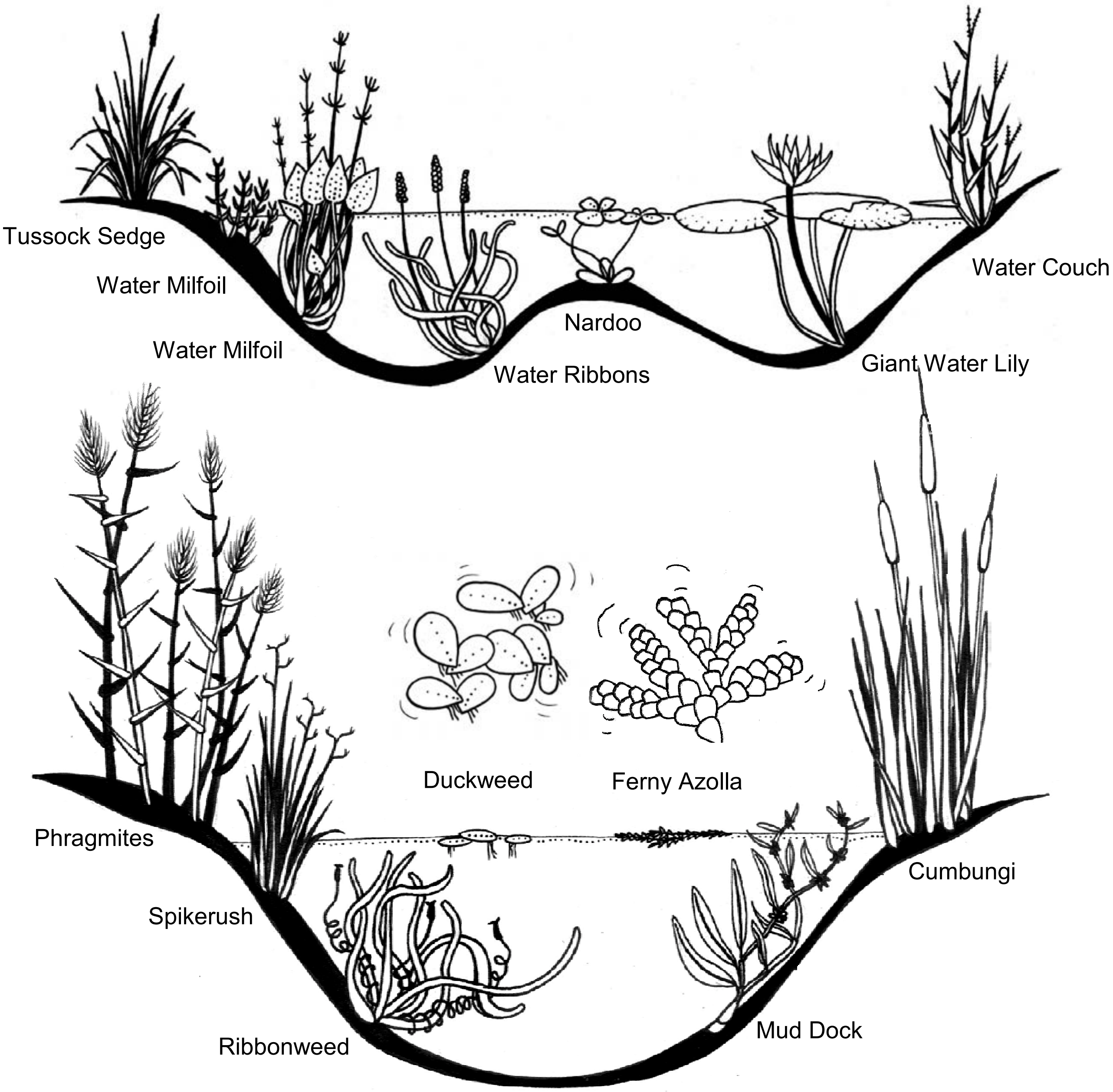
My water plant lives in the water:

☐ on top  ☐ underwater  ☐ edge 

My plant is: ☐ tall ☐ flat

My plant has leaves that are: ☐ round ☐ long and flat

6.6 Water plant identification chart

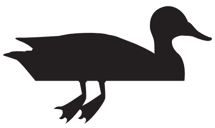
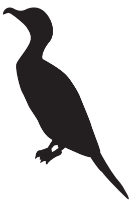


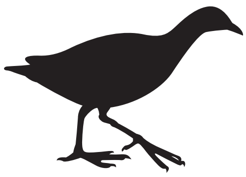
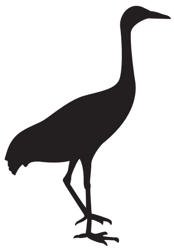
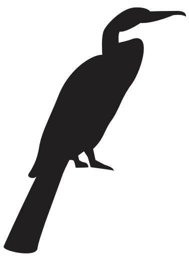
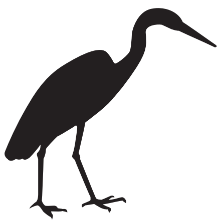
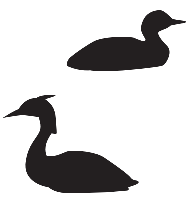
6.7 Waterbird identification chart

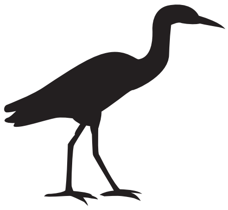
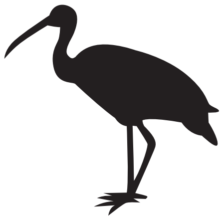
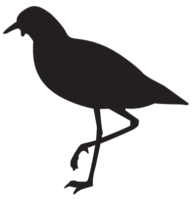
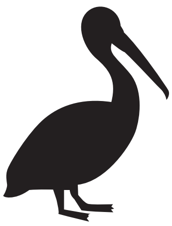
Nomadic: moves to meet need for food and water

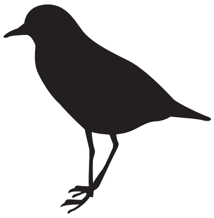
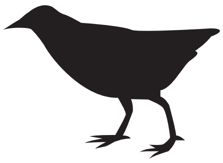
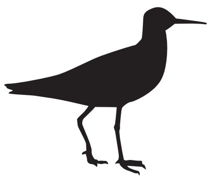
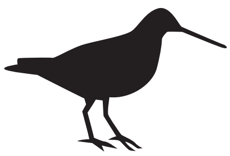
Resident: stays in the same location

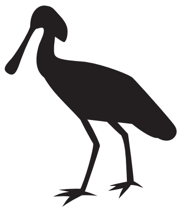
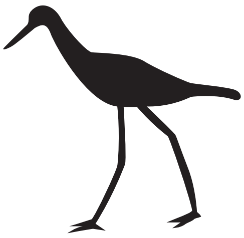
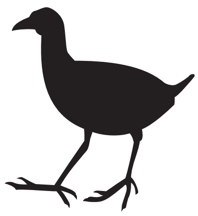
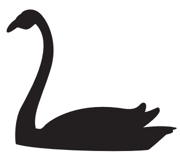
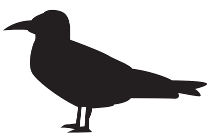
Migratory: moves with the seasons

Bird	Distribution	Diet	Preferred habitat	Nesting
Bittern 	Most of NSW except far NW Nomadic	Feeds mainly at night on frogs, fish, yabbies, spiders, insects and snails	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spike-rushes (*Eleocharis* spp.)	Breeding occurs in summer from Oct–Jan, on a platform of reeds
Black duck 	Throughout NSW Resident	Aquatic invertebrates and water weeds. Filter feeds. Puts head in water and stirs up bottom	Flowing and still water (can live in polluted water)	July–Nov. Nests in vegetation – can use poor quality vegetation
Coot 	Throughout NSW Nomadic	Plant matter	Lakes and still water	Aquatic vegetation carried back to the nest after being collected by diving. Nests may be floating
Cormorant 	Throughout NSW Migratory	Aquatic invertebrates, frogs and fish	Large water bodies several metres deep	Breed in colonies only after inland flooding

Bird	Distribution	Diet	Preferred habitat	Nesting
Crake 	Most of NSW except far north. Resident	Aquatic insects, larvae, hatching flies, tadpoles, invertebrates. Always feeds under cover	Shallows and margins of freshwater or saline wetlands	Nests in reeds Aug–Feb
Crane: brolga 	SE Australia Nomadic	Fleshy parts of aquatic plants, aquatic insects such as dragonflies and beetles, spiders, frogs and small fish	Shallow swamps and flooded grasslands	July–Dec in herb and sedge swamps with nests of floating vegetation away from the shore
Darter 	Throughout Australia Resident	Insects, fish or tortoises	Freshwater and saline lakes, swamps and rivers, prefers sheltered areas	Breeds in spring and the male will defend a site and decorate it with leafy twigs. Nests tends to be solitary in summer
Egret 	Throughout NSW Nomadic	Fish, frogs and invertebrates	Still water or still parts of flowing water	Sept–Nov in small colonies
Grebe 	Throughout NSW Resident	Small fish and water insects	Wetlands	Sept–Jan in the south and Jan–Apr in the north

Bird	Distribution	Diet	Preferred habitat	Nesting
Heron 	Throughout NSW Resident and nomadic depending on type	Fish, frogs, tadpoles, aquatic invertebrates and vegetation	Still water (e.g. wetlands and dams) and still parts of flowing water. Hunts in the shallows	Different species breed at different times throughout the year. May breed outside of season in response to rainfall
Ibis 	Throughout NSW Nomadic	Terrestrial and aquatic invertebrates, crayfish and mussels	Swamps, lagoons, flood plains, grasslands, parks and gardens	One or two broods may be reared in a year
Lapwing 	Throughout NSW Resident	Insects, crabs, worms, yabbies and other small crustaceans, invertebrates, seeds and herbage	Swamps, flooded grounds with short grass, paddocks with dams, airfields, near beaches and wetlands	Masked lapwings may breed at any time when conditions are suitable
Moorhen 	Throughout NSW Nomadic	Seeds and aquatic vegetation	Found in freshwater wherever there is aquatic vegetation	Nests of aquatic vegetation and may be floating
Pelican 	Throughout NSW Nomadic	Fish, aquatic animals including crustaceans, tadpoles and turtles	Throughout the continent wherever there is water. Widely distributed in cool temperate to tropical lakes, rivers and estuaries	Colonial breeder – may breed at any time throughout the year

Bird	Distribution	Diet	Preferred habitat	Nesting
Plover 	Widespread across NSW and not usually found outside Australia	Invertebrates such as worms, snails and water beetles, and plant material such as seeds	Small bodies of water and farm dams	Nests scraped out of gravel within about 15 metres of the water's edge
Rail 	Throughout NSW Resident	Crustaceans, molluscs, insects, seeds, fruit, frogs, carrion and refuse. Mostly feeds early in the morning and the evening	Dense reeds and vegetation bordering many types of wetlands or crops. Makes widespread use of artificial wetlands like sewage ponds and drainage channels	Nests in long grass, tussocks, rushes or crops
Sandpiper 	Throughout NSW Migratory	Invertebrates such as worms, snails and water beetles, and plant material such as seeds	They are waders and feed along the edge of lakes	Main breeding season May–Aug in Northern Hemisphere
Snipe 	Throughout NSW Migratory	Invertebrates such as worms, snails and water beetles, and plant material such as seeds	Inhabits shallow freshwater wetlands, vegetated ephemeral and permanent lakes and swamps, and inundated grasslands	Nests on the ground amongst tall vegetation such as grass tussocks and reeds

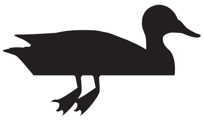
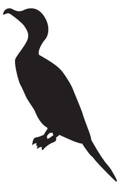
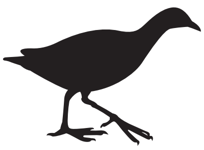
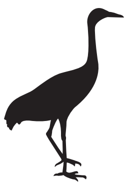
Bird	Distribution	Diet	Preferred habitat	Nesting
Spoonbill 	Throughout NSW Nomadic	Fish and other water animals, such as shellfish, crabs and frogs	Wetlands and in the shallow parts of lakes and rivers	Main breeding season Oct–Apr. When they are breeding, long white feathers grow from the back of their heads
Stilt 	Throughout NSW Resident	Molluscs, insects, diatoms, brine shrimp from mud	Edge of still water (up to feather line)	Aug–Nov in small colonies. Don't need much vegetation to nest
Swamphen 	SE NSW Nomadic	Reeds, stems, grass and little animals	Still waters	July–Nov in reeds. Also uses reeds for shelter
Swan 	Prefers southern parts NSW Resident	Vegetation – submerged plants, algae. Grazes on pasture on banks	Salt, brackish or fresh waterways and permanent wetlands, requiring 40 metres or more of clear water to take off	April–Jan. Prefers wet season when sufficient vegetation can be uprooted to form a platform nest
Tern 	Migratory bird to Australia	Insects taken on the wing (dragonflies), water insects (beetles) and grasshoppers. Small fish and crustaceans also eaten	Shallow swamps, coastal dwellers	Breeding in summer on islands or a twig structure anchored to the bottom

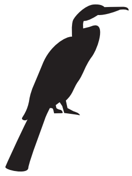
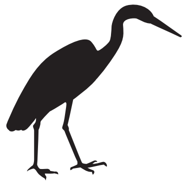
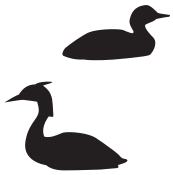
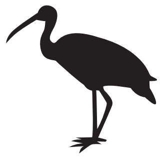
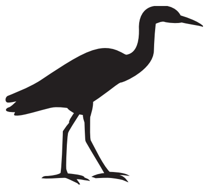
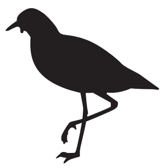
6.8 Water bird field observation sheet

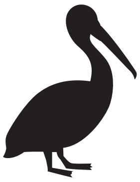
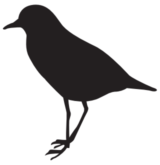
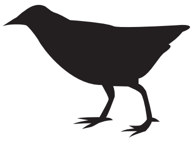
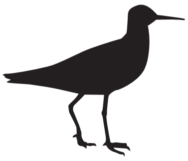
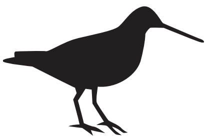
Site name: ....

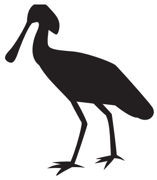
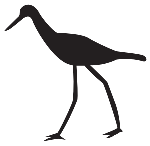
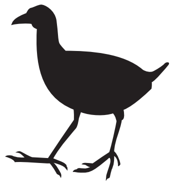
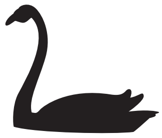
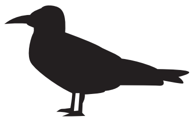
Date: ....

Below are some common waterbirds that you may see at your site.
Record the number for each type of waterbird you observe.

Bird	Number
Australian bittern 	
Black duck 	
Coot 	
Cormorant 	
Crake 	
Crane: brolga 	

Bird	Number
Darter 	
Egret 	
Grebe 	
Ibis 	
Heron 	
Lapwing 	

Bird	**Number**
Moorhen 	
Pelican 	
Plover 	
Rail 	
Sandpiper 	
Snipe 	

Bird	**Number**
Spoonbill 	
Stilt 	
Swamphen 	
Swan 	
Tern 	

Make a list of other birds seen at the site that may **not** be waterbirds.

....

....

....

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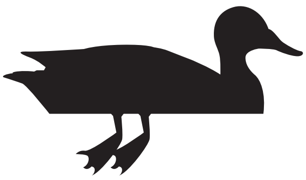
....

6.9 Beaks and feet information sheet

Different features of birds allow them to live and feed in different parts of the wetlands.

Duck

Flat bill for sifting mud and webbed feet for swimming.



duck

Cormorants and darters

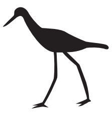
Usually found in open water because they catch fish by swimming and diving.

diving cormorant

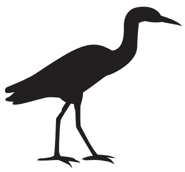
diving darter

Stilts and herons

Long legs for wading through shallows and long bill for reaching.



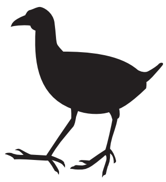
stilt



heron

Swamphen

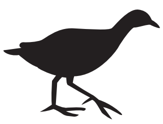
Wide feet for walking on weeds and a short beak for grabbing leaves and slugs.



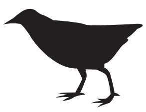
swamphen

Crakes and rails

Small birds with relatively long legs and long toes that allow them to move through thick vegetation that often fringes wetlands.



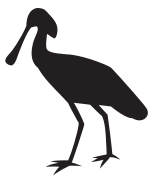
crake



rail

Spoonbill

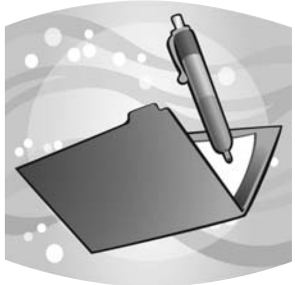
Large bird with a long beak shaped like a spoon, to scoop up its food from the bottom of the wetland bed. Long legs are for wading through shallow water.



spoonbill

Based on *Catchment Education Resources Book*, Vic. Dept of Natural Resources.

6.10 Beaks and feet field observation sheet



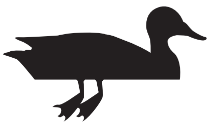
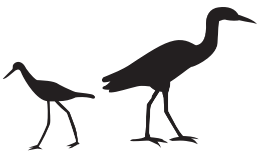
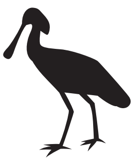
Site name: ....

Date: ....

Refer to the beaks and feet information sheet (Section 6.9).

For the following groups of birds:

1. Count the number of each type.
2. Record where they were seen: open water, edge or among plants.

Bird group	**Number**	**Location** O= open water E= edge V= in vegetation	**Beak/feet activity** F = feeding S = swimming D = diving W = wading WOP = walking on plants
Ducks 			
Cormorants and darters 			
Stilts and herons 			
Spoonbills 			

6.11 Bird and animal assessment work sheet

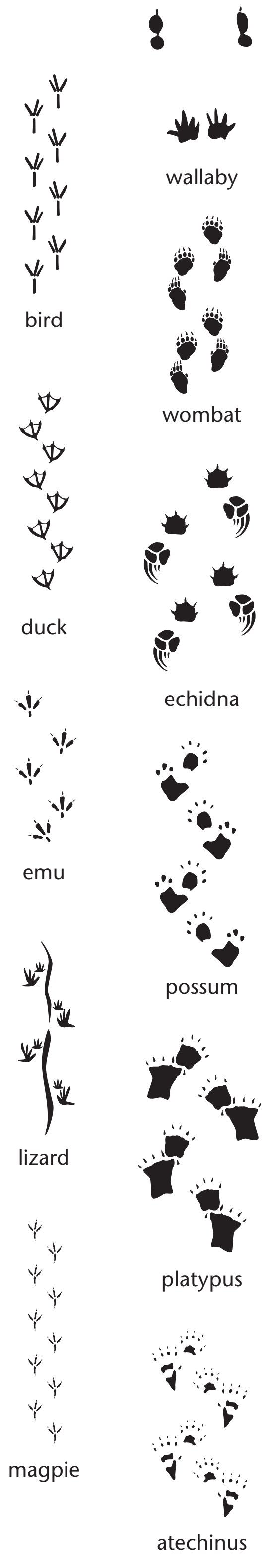
Site name: ....

Date: ....

The native animals I can see: ....

....

....



The birds I can see: ....

....

....

Other evidence of native animals and birds:
(Tick the things you can see)

- ☐ claw marks
- ☐ scats (animal droppings)
- ☐ animal calls
- ☐ reptile skins
- ☐ burrows
- ☐ paw marks in the soil
- ☐ nests
- ☐ feathers
- ☐ fur
- ☐ web
- ☐ other ....

Other animals observed: ....

....

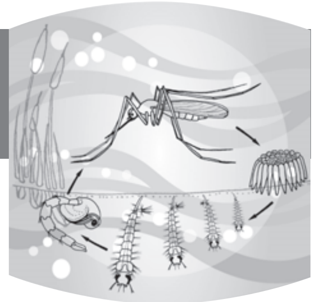
....

Indirect evidence of other animals: ....

....

....

SECTION 7



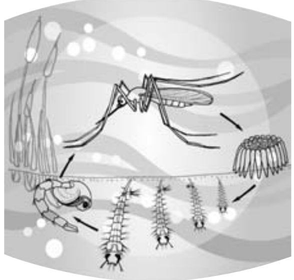
Water bug (macroinvertebrate) survey

Water bugs, also known as macroinvertebrates, are small creatures with no backbone that can be seen with the naked eye. Different kinds of water bugs have different tolerances to pollution and can therefore provide an indication of the health of your waterway. A healthy waterway will have an abundance and wide diversity of water bugs.

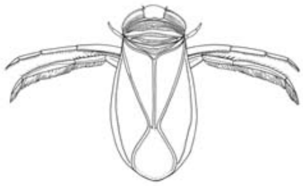
Collecting, identifying and examining water bugs is great fun and a valuable learning experience for students. It is easy to get involved in the spring and autumn water bug surveys and use the results to ascertain the health of your creek or river.

Note: Background information for the water bug (macroinvertebrate) survey is provided in the *Junior Waterwatch Teachers' Guide*. Student work sheets and fact sheets about water bugs are also available in the teachers' guide.

7.1 Doing a water bug (macroinvertebrate) survey

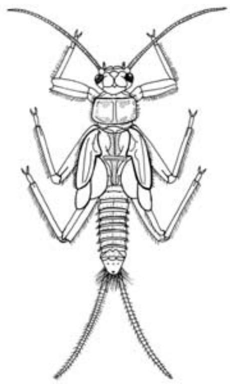


What are water bugs?



Water bugs or aquatic macroinvertebrates are small creatures that have no backbone and can be seen with the naked eye. They live all or part of their life in water, providing a food source for larger animals such as fish, frogs and birds. Macroinvertebrates include snails, beetles, dragonflies, yabbies and worms.

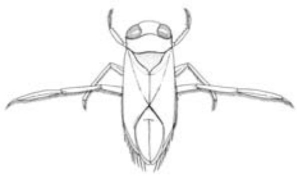
> **Macro = visible to the naked eye**
> **Invertebrate = animal without a backbone**



Water bug sampling can provide a rapid assessment of the condition of a site at a particular time. When compared to other locations, these studies can provide useful information about the health of the aquatic ecosystem.

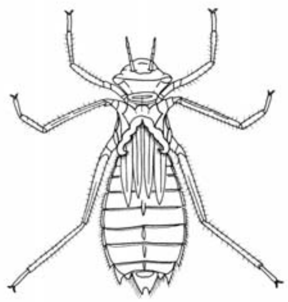
Designing a water bug study

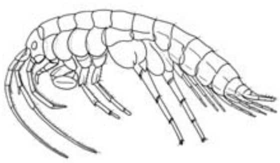
Step 1: Identify the sampling objectives

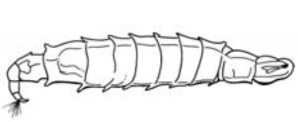


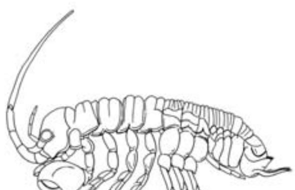
Identify the purpose for your study as this will determine sampling sites and methods. Some studies may be conducted to:

- gain a better understanding of the different types of water bugs
- compare the site with other sites in their natural condition
- estimate changes over time in the composition and abundance of water bugs
- compare changes in water bugs over time following management actions.

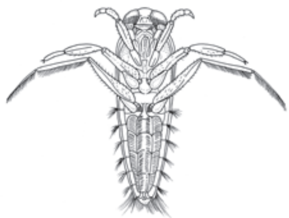








Step 2: Monitoring plan



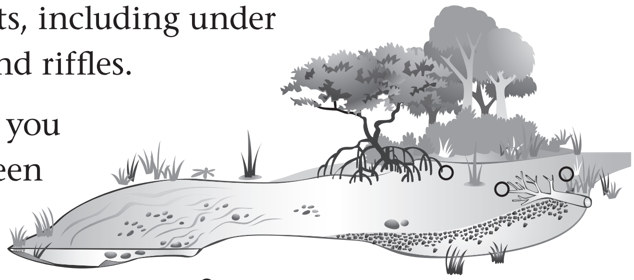
Where in the catchment should I place my monitoring sites?

Select sites that meet the objectives of your study. This may involve the selection of more than one site if comparative studies are required.

Where should I sample in the stream?

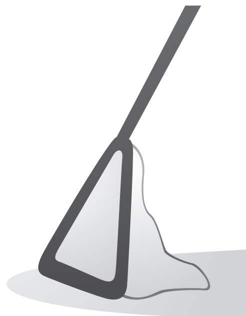
Within the stream, sample a range of habitats, including under stones, logs, fringing vegetation and pools and riffles.

Sample in roughly the same place each time you visit so that comparisons can be made between data collected at different times.



What equipment should I use?

Waterwatch prefers nets with a triangular frame and fine net dip bag. See tips for student macroinvertebrate sampling at the end of this section.



When should I sample?

Sampling should occur twice a year, preferably in spring (October) and autumn (March).

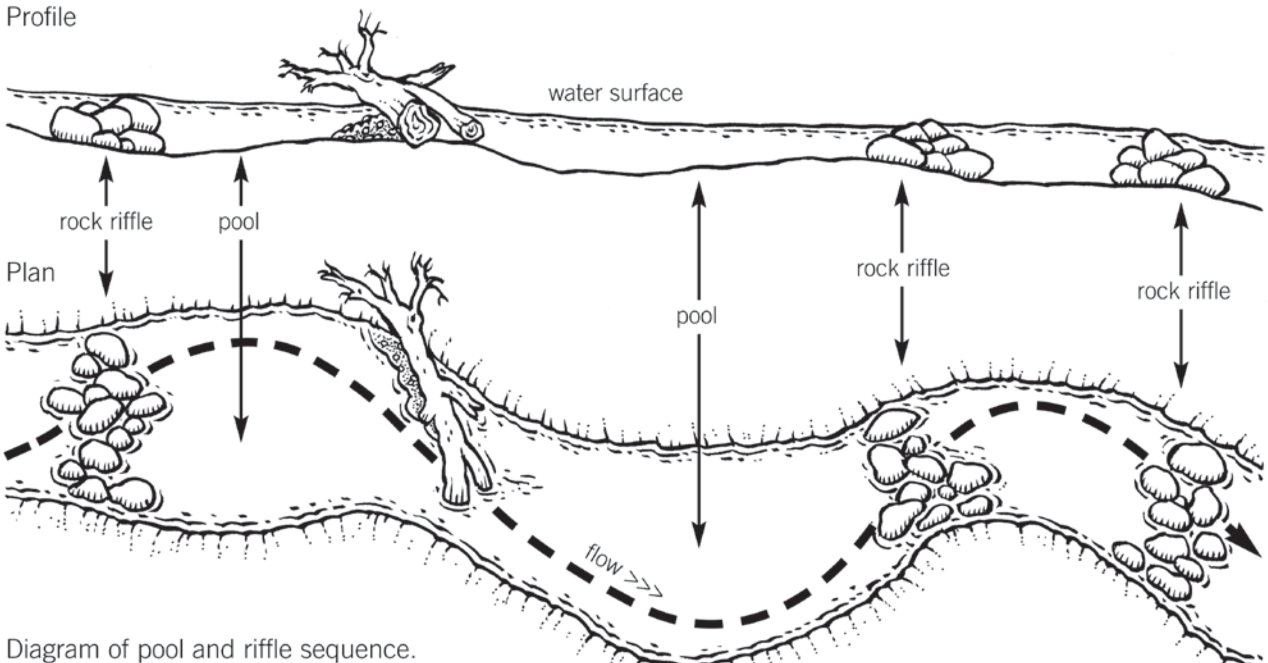


Diagram of pool and riffle sequence.
Illustration Paul Lennon.

Step 3: Type of sampling

Use nets to sample 10 metres of stream for at least 10 minutes.

> **Note:** **Edge sampling is prescribed for school students due to the OH&S issues related to students entering creeks, rivers and estuaries.**

Edge sampling procedures

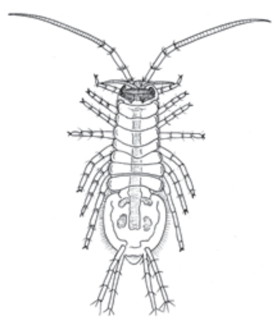
Collecting a sample

Time: 5–10 minutes

1. Pour clear stream water into a large white sorting tray to about 2 centimetres deep and put the tray close to the edge of the water.

Note: Where it is difficult to lie the tray flat at the water's edge, use a bucket and transfer the water into trays after sampling.

2. Use a short upward-sweeping motion to sweep the net through the water. Make sure all habitats are sampled, including fringing vegetation, along 10 metres of stream. Sample the top, edge and bottom of the water.



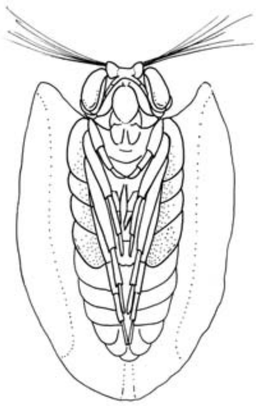
3. Stop regularly to transfer the water bugs gently into the tray. Turn the net inside out and wash its top in the tray to transfer the bugs.

4. Rinse any mud or fine silt from your net. The sample should be free of sediment prior to sorting.

5. Spread the sample out in the tray so small water bugs can be seen.

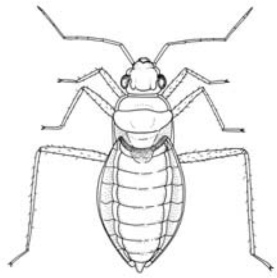
Sorting the sample

Time: 30–40 minutes



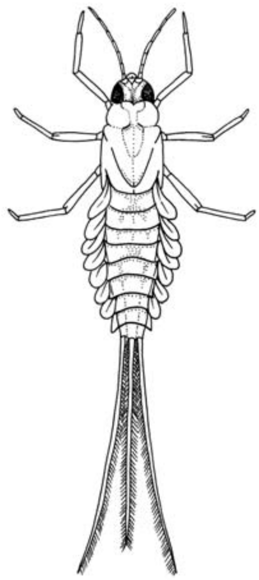
6. Observe the water bugs in the large white sorting tray.

> **Testing tip:** **Aim to collect at least 50 water bugs per sampling area and as many types as possible.**
> **It is not possible to calculate the stream pollution index unless you have 50 water bugs.**



7. Each group should fill an ice block tray with a small amount of water.

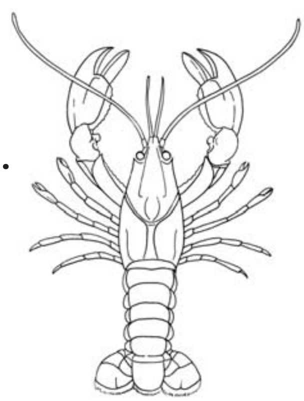
8. Transfer bugs to the ice block trays using plastic spoons, pipettes, paintbrushes and tea strainers.



9. Sort the water bugs into the cubes in the tray, using a different cube for each type.

Identifying the species and recording the results

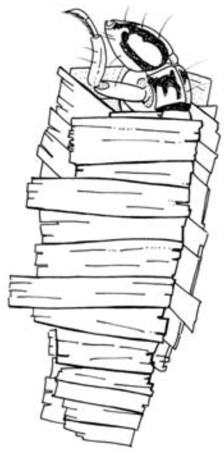
10. A person trained in macroinvertebrate identification should be invited to assist. This may be a Waterwatch coordinator, professional person such as a CMA or local government staff member, or a trained teacher.



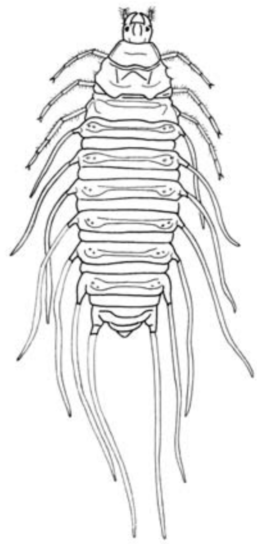
11. Use the *Water Bug Detective Guide* to help you identify the species.

12. Count the total number of water bugs and the number of different types.

13. Record the information on the recording sheet provided (Section 7.3). This will give an indication of the health of your waterway based on the scores provided for each bug type and the number of water bug types collected. The sensitivity score provides an indication of the tolerance of each water bug to pollution and is sometimes called a SIGNAL score.



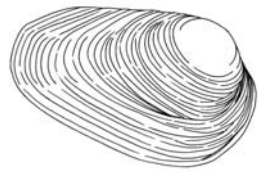
> *i* **Note: The macroinvertebrate sensitivity score (SIGNAL) and the stream pollution index (SPI) give an indication of water quality at the site where the sample was collected.**



14. Return the water bugs to the water gently once you have finished, as close to the collection site as possible.

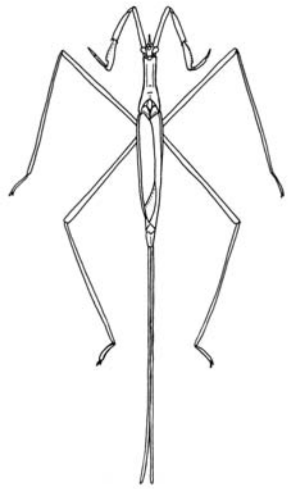
What do your results mean?

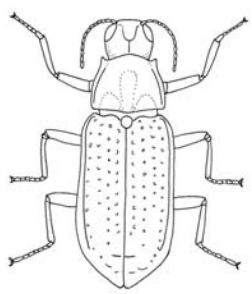
To provide an indication of water quality at your site, it is important to take into account the location of your site and whether it has flowing or standing water. Inland streams usually have a lower diversity of species than coastal freshwater streams. Wetlands will have a lower diversity than flowing water.

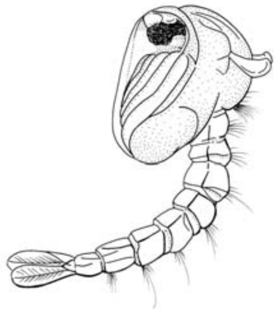


The stream pollution index (SPI), together with the number of water bug types, provides information about water quality at your site.

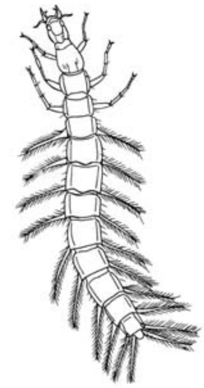
> *i* **Note: For further information about calculating the SPI, see the worked example in Section 7.3.**







Tips for student macroinvertebrate sampling

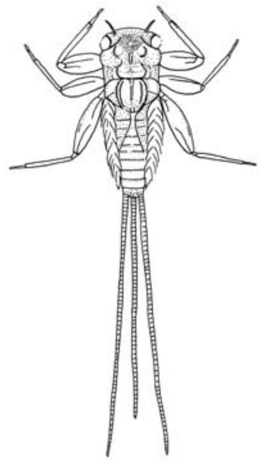


Nets: These can be made from a kitchen strainer attached to a broom handle, stick or piece of dowel. This net is ideal for bugs as it will last many trips to the river and is inexpensive to make.

> **Note:** The ***Junior Waterwatch Teachers' Guide*** **has instructions for students to make their own sampling nets**

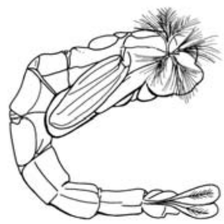
Scooping: Divide the class into groups of 4–5 students. Each group is to work in a specified location and remain there.

Sorting: After 5 minutes of scooping, students put the nets down and carry their trays away from the water's edge for sorting. This will ensure that students concentrate on the sorting of the bugs.



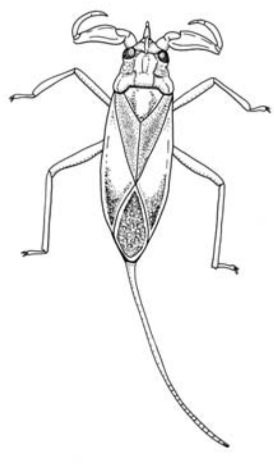
Identifying the species: Invite a trained person to assist with identification. Direct students to look for colour, shape, position of the legs and the number of tails. A two-way microscope or magnifying glass may assist with identification.

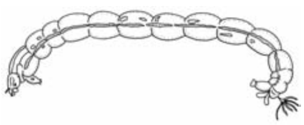
Calculating the stream pollution index (SPI): By entering the results of your bug survey on the water bug website, the pollution index for your site and the number of water bug types will be calculated. A description of your site will be provided **based on the water bugs you have collected**.

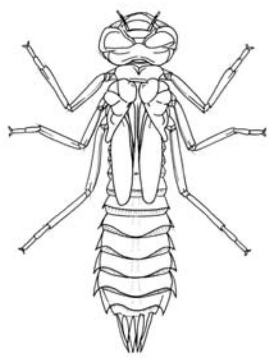


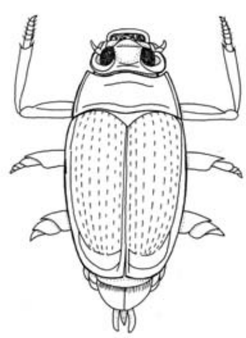
What your results mean: The water bug survey will provide an indication of the habitats and water quality at your site. There may also be other factors at your site that may be affecting the number and variety of bugs. You can add these factors to your survey results.

> **Note: For more information check the website: www.waterwatch.nsw.gov.au**

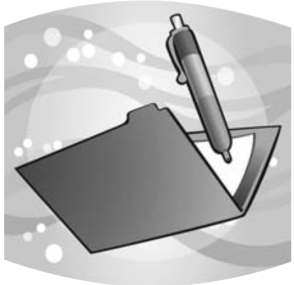






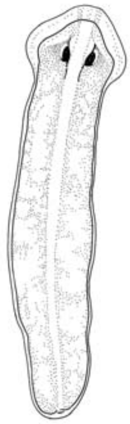


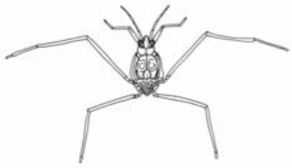
7.2 Water bug survey: teacher checklist

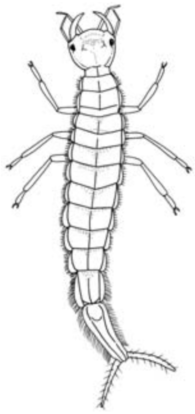


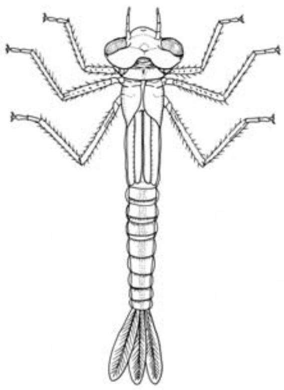
Date: .... Class: ....

Item	Checked
TEACHER ORGANISATION	
Permission notes	☐
Class list	☐
Special needs student list	☐
Risk assessment sheet for completion	☐
Buses (if applicable)	☐
First aid kit	☐
Sunscreen	☐
Student medications	☐
Mobile phone	☐
STUDENT CLOTHING	
Hats	☐
Closed toe shoes	☐
Drinking water	☐
FIELD EQUIPMENT	
Bucket	☐
Large trays	☐
Ice cube trays	☐
Spoons, pipettes, brushes	☐
Magnifying glass (optional)	☐
Macro nets	☐
RECORDING AND ID SHEETS	
Pencil case	☐
Marker pens	☐
Folder of result sheets + info	☐
Clipboards	☐
Camera	☐
Bug identification laminates	☐
Gambusia information sheet	☐









7.3 Water bug survey: SIGNAL 2 field recording sheet

Sampler group name:...

Number in group:..

Survey period: ☐ Spring ☐ Autumn ☐ Other...

Date:.. Time: .... Time taken (hours):.................................

Location of water body:

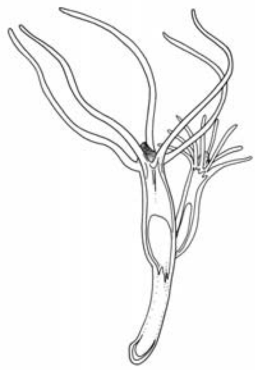
☐ western river or stream <300 metres above sea level

☐ other rivers and streams ☐ wetland

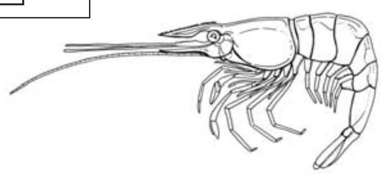
Note: The rating of your stream pollution index (SPI) will be affected by the location of the sampling.

Habitats sampled:

Habitat *(tick the boxes where you sampled)*	**Still water**	**Moving water**
Silt and sand	☐	☐
Stones	☐	☐
Water plants	☐	☐
Leaves and twigs	☐	☐
Logs, branches, tree roots	☐	☐



Note: The more habitats sampled the greater the expected number of bug types.



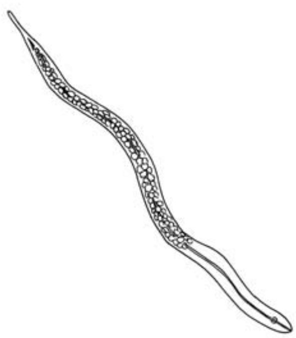
Sampling methods: *(tick the boxes)*

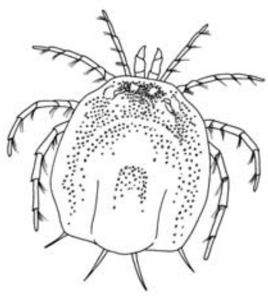
☐ sweep ☐ kick

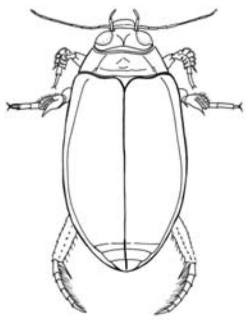
Identification of bug species confirmed by a trained person: ....

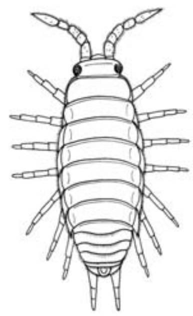
....

(e.g. Waterwatch Coordinator, professional staff of council or agency, experienced teacher or community member)









Water bug survey: SIGNAL 2 result sheet

Survey site name: ....

Step 1: Tick the bug type if present.
Step 2. Enter the number of each bug found in Column B.
Step 3: Refer to the weight table for the correct weight factor for the number found.
Step 4: Enter the correct weight factor for each bug in Column C.
Step 5: Multiply the bug value (Column A) by the weight factor (Column C) and enter the answer in Column D.
Step 6: Add up Column C (weight factors).
Step 7: Add up Column D (bug value x weight factor).
Step 8: Add up the number of bug types.

WEIGHT TABLE	
No. of each bug found (Column B)	Weight factor (Column C)
1–2	1
3–5	2
6–10	3
11–20	4
>20	5

Water bug recording table

MACROINVERTEBRATE TYPES			A	B	C	D
Sensitivity rating	Taxa richness (bug types)	Tick if present	Sensitivity rating	Number of bugs	Weight factor	Column A x Column C
Very sensitive	Stonefly nymph	☐	10			
	Mayfly	☐	9			
Sensitive bugs	Alderfly larva	☐	8			
	Caddisfly larva	☐	8			
	Riffle beetle and larva	☐	7			
	Water mite	☐	6			
Tolerant bugs	Beetle larva	☐	5			
	Dragonfly nymph	☐	4			
	Water strider	☐	4			
	Whirligig beetle and larva	☐	4			
	Freshwater yabby/crayfish	☐	4			
	Damselfly nymph	☐	3			
	Fly larva and pupa	☐	3			
	Midge larva and pupa	☐	3			
	Freshwater mussel	☐	3			
	Nematode	☐	3			
	Freshwater sandhopper	☐	3			
	Freshwater shrimp	☐	3			
	Water scorpion/needle bug	☐	3			
Very tolerant bugs	Diving beetle	☐	2			
	Flatworm	☐	2			
	Hydra	☐	2			
	Water treader	☐	2			
	Freshwater slater	☐	2			
	Water boatman	☐	2			
	Freshwater worm	☐	2			
	Backswimmer	☐	1			
	Bloodworm	☐	1			
	Leech	☐	1			
	Mosquito larva and pupa	☐	1			
	Freshwater snail	☐	1			
	TOTALS	☐				

Did you catch *Gambusia* at your site? ☐ Yes ☐ No ☐ Did not look

7.4 Calculating the health of your site

Step 1: Count the number of bugs (taxa richness) **Number of bug types:** ☐

Step 2: Calculate the SPI = **Total Column D** ☐ / **Total Column C** ☐ = ☐

Step 3: Classify the number of bug types and SPI as high or low based on your site description and the levels in the rating table:

Taxa richness (number of bug types) = ☐ **High** ☐ **Low**

SPI = ☐ **High** ☐ **Low**

Bug type and SPI rating table

Site description	SPI		Taxa richness (bug types)	
	Low	**High**	**Low**	**High**
Wetlands	0–3.1	>3.1	0–14	>14
Western rivers below 300 metres	0–3.1	>3.1	0–11	>11
Other rivers and creeks	0–3.5	>3.5	0–15	>15

Step 4: Identify the site conditions based on your bug count.

SPI rating table

SPI rating	Taxa richness	Site conditions based on the macroinvertebrate sample
High	High	Good water quality and a diversity of habitats. It may be a well-managed site, natural bushland or a national park.
Low	High	Water quality may be slightly affected by human activity or natural factors. There may be higher levels of salinity and/or nutrient levels at the site.
High	Low	Water quality is affected by a pollution source upstream or there are few habitats due to harsh physical conditions.
Low	Low	Water quality is affected by human use such as urban, industrial or agricultural pollution or by the downstream effects of dams.
		Unable to calculate an SPI as there are fewer than 50 macroinvertebrates in the sample. This may indicate that your site is under stress. There may be poor habitat diversity and/or water quality. Make sure you sample in all habitats and keep an eye on the site.

Step 5: If the table does not represent your site, what other factors may influence water quality at your site? ....

....

Note: These may change over time and may include rainfall, river flow, land use, drains, condition of banks and riparian vegetation.

Upload your results to the water bug survey website at www.waterwatch.nsw.gov.au. The online database will calculate the stream pollution index (SPI) and provide a description of your site based on the bugs collected.

Worked example

Enter your results in the recording table and complete Column C by referring to the weight factor table (see blank recording sheet). Complete Column D by multiplying the sensitivity rating by the weight factor. For example, 3–5 bugs has a weight factor of 2. Multiply the sensitivity (Column A) by the weight factor (D). For stonefly in the example below, this is 10 x 2 = 20.

Extract from a water bug recording table

Bug type			A	B	C	D
Bug sensitivity	**Bug types**	**Tick if present**	**Sensitivity rating**	**Number of bugs found**	**Weight factor**	**Column A x Column C**
Very sensitive	Stonefly nymph	✓	10	3	2	20
Sensitive	Water mite	✓	6	20	4	24
Tolerant	Whirligig beetle and larva	✓	4	11	4	16
	Freshwater yabby/crayfish	✓	4	2	1	4
	Damselfly nymph	✓	3	5	2	6
	Freshwater shrimp	✓	3	30	5	15
Very tolerant	Water boatman	✓	2	16	4	8
	Freshwater worm	✓	2	15	4	8
	Mosquito larva and pupa	✓	1	12	4	4
	Freshwater snail	✓	1	33	5	5
	TOTALS	10		147	35	110

Calculate the stream pollution index (SPI)*.

Step 1: Calculate the (SPI) = $\frac{\text{total of Column D}}{\text{total of Column C}} = \frac{110}{35} = 3.2$

Step 2: Count the number of bug types: Bug types = 10

Step 4: Classify as high or low the number of bug types using the table provided

Step 5: Based on your SPI and the number of bug types, the condition of your site may be classified as:

SPI rating	Number of bug types	Site conditions based on the macroinvertebrate sample
Low	Low	Your results may indicate that water quality is affected by human use such as urban, industrial or agricultural pollution or by the downstream effects of dams.

If the table does not represent your site, what other factors may influence water quality at your site?

Note: These may change over time and may include rainfall, river flow, land use, drains, condition of banks and riparian vegetation.

Upload your results to the water bug survey website at www.bugsurvey.nsw.gov.au. The online database will calculate the stream pollution index (SPI) and provide a description of your site based on the bugs collected.

SECTION 8

Human impacts on waterways

Human activity has modified the natural environment and this has led to many environmental problems, also known as environmental issues. Some of the most significant of these issues are increased soil and river salinity, land degradation, water pollution, loss of biodiversity and climate change. Management of these issues while maintaining the productivity and sustainability of the natural environment is a key challenge for the future.

This section comprises work sheets to help students explore these issues at their river, creek or estuary.

> *i* **Note: Background information about human impacts on waterways is provided in the *Junior Waterwatch Teachers' Guide*. More student work sheets and fact sheets about this topic are also available in the teachers' guide.**

8.1 Types of litter at the creek work sheet

Site name: ....

Date: ....

When people use the creek, sometimes they leave behind litter or rubbish.

From the words below, circle the rubbish which you can see at your creek.

plastic   food wrappers   straws

paper   glass   drink bottles

old car   tissues   food

cartons   plastic bags   paddle pop sticks

cans   matches   cigarette butts

lawn clippings   shopping trolleys

What other litter did you find at the creek? ....

....

....

....

8.2 Litter survey work sheet

Site name: ....

Date: ....

Conduct a litter survey to find out about the litter at your site and make these lists:

Natural litter	Human-made litter

Litter I can see which can be recycled: ....

Litter I can see which can make compost: ....

Litter I can see which can be re-used: ....

Litter scale: rate your creek *(mark how your creek rates along the line)*

0 1 2 3 4 5 6 7 8 9 10

very poor — very good

8.3 Rules for people at the site work sheet

Site name: ....

Date: ....

Rules help make people act responsibly. Look at the signs at your river, creek or estuary.

Who put up the signs? Why?

....

....

....

Draw 3 signs you can see or think should be at the site.