NSW GOVERNMENT | Office of Environment & Heritage

Guide to water quality monitoring

Warrumbungle National Park

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Published by:
Office of Environment and Heritage NSW
59 Goulburn Street, Sydney NSW 2000
PO Box A290, Sydney South NSW 1232
Phone: (02) 9995 5000 (switchboard)
Phone: 131 555 (environment information and publications requests)
Phone: 1300 361 967 (national parks, climate change and energy efficiency information, and publications requests)
Fax: (02) 9995 5999
TTY: (02) 9211 4723
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

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Contents

1. Introduction

In February 2013 a severe bushfire devastated much of the Warrumbungle National Park. This was followed soon after by an intense thunderstorm that washed large quantities of sediment, organic matter and nutrients from the hill slopes into the streams that drain the park. Scientists from the Office of Environment and Heritage (OEH) are tracking the progress of sediment and nutrient movement through the stream system. Nutrient concentrations can reach very high levels following bushfires, altering the character of the stream ecosystem by promoting excessive plant and algal growth and growth of biofilms on stones, wood and sediments. In addition to this, the sediment is being moved down the streams as massive slugs of sand, smothering aquatic habitats and filling pools. This is particularly obvious in Wambelong Creek which traverses the valley floor through the heart of the national park.

Your measurements of water quality will contribute valuable information to complement the scientists' studies on the recovery of these streams following the bushfire. In addition, we have set up the water quality component so that you can compare different methods of measuring water quality and you will help us understand what the best methods to sample water quality are.

The scope of the student studies will be to focus on the recovery of a section of the Wambelong Creek along the valley floor in the vicinity of the Warrumbungle Environmental Education Centre (WEEC).

This sampling manual instructs students how to measure water quality. We are currently testing the protocol outlined in the manual to see if it is sufficiently robust.

2. Monitoring sites

The proposed study reach is on Wambelong Creek near the Visitor Centre and Education Centre (WEEC). Wambelong Creek and an unnamed tributary (Ck1) near the WEEC, are badly affected by massive slugs of sand which have greatly simplified aquatic habitats for fish and other aquatic animals. The sand has filled the pools in Wambelong Creek and smothered the former gravel and cobble stream bed leaving a uniform, flat stream bed. The monitoring sites are:

Site 1: immediately downstream of road crossing on a bend in the stream. This site had a deep pool prior to the fire which has since filled with sand.

Site 2: located across from the Education centre. This site is suitable for monitoring water quality in Wambelong Creek.

Sites 1 and 2 are within walking distance of the Wambelong Creek near the Visitor Centre and Education Centre (Fig. 1) and could form the basis for long-term monitoring of the recovery of Wambelong Creek on the valley floor.

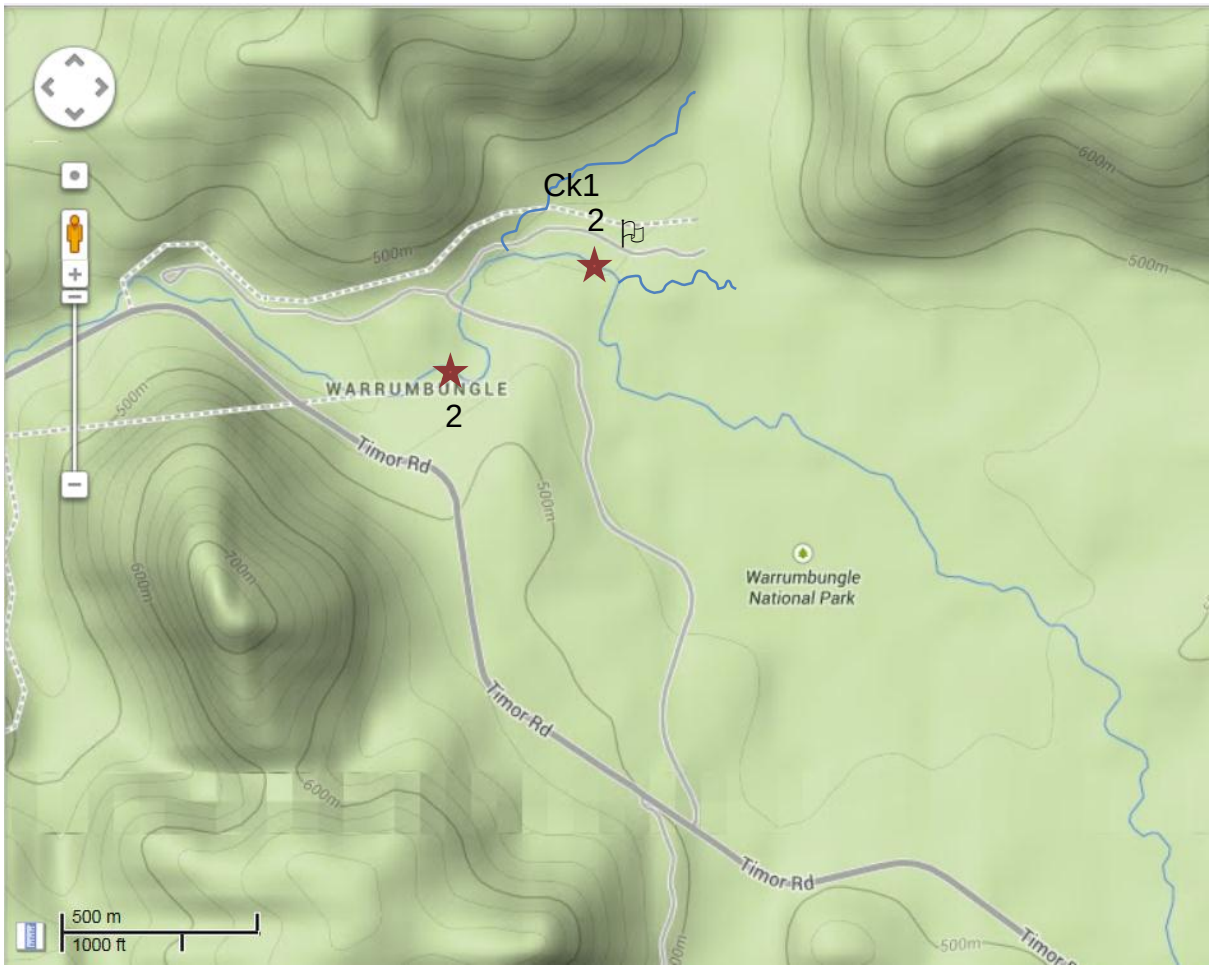

Figure 1. Map of the area of Warrumbungle National park near the visitor and education centres. Student monitoring sites are shown as red stars.

3. Water Quality Indicators

The water quality indicators listed in Table 1 are to be measured using a combination of equipment and a Horiba water quality meter.

Table 1. List of indicators to be measured for assessing water quality in Warrumbungle National Park.

Water quality indicator	Reason for measurement	Method of measurement
Salinity (measured as Electrical conductivity)	Monitor trends in surface water salinity. Impacts on biodiversity	Conductivity meter Horiba probe
pH	Indicator of acidity of the water. High pH causes ammonia toxicity and metal uptake by organisms	pH Litmus paper test Horiba probe
Water temperature	Driver of metabolic processes and reactions	Thermometer Horiba probe
Nutrients	Can become elevated after fire These may cause rapid algal and plant growth.	Collect sample for OEH laboratory
Biofilm growth	Affects the composition of aquatic animal communities	Collect sample for OEH laboratory Drying method

4. Overview of Water Quality Sampling Procedure

Students should work in pairs or small groups of three to four.

4.1 List of Sampling Equipment

- Conductivity meter
- Thermometer
- pH papers
- small 200 mL plastic beakers or containers for testing pH and conductivity
- Filtration syringe and 0.45 µm Minisart filter papers
- 3 x 30 mL sample vials for nutrients
- Esky and ice for storing nutrient samples
- Data recording sheets, clip board and pencils
- Latex gloves
- Distilled water in a wash bottle
- Horiba U-10 water meter
- Labels for sample bottles
- Waste container for tissues, used pH strips and filter papers

4.2 Collecting the water sample

You will need a sample pole with sample bottle attached.

It is very important not to enter or disturb the water before a water quality sample is taken. Wading into the water will stir up sediments from the bottom which will affect the water quality.

Figure 2. Example of the water sampling technique.

Use a sampling pole with a sample bottle attached to take your water sample. The water sample needs to be representative of the water flowing in the stream, so choose a spot where the water is well mixed such as downstream of a riffle or cascade. If you are sampling a pool, take the sample from at least a metre out from the bank in the main flow of the stream (Fig. 2). Take the sample from 10-20 centimetres below the surface of the water, although this may not always be possible in very shallow streams.

4.3 Electrical conductivity

You will need:

- Conductivity meter (Fig. 3)
- Distilled water in a wash bottle
- Horiba U-10 water meter

4.3.1 Procedure

1. Follow protocol on how to collect a water sample.
2. Dip the conductivity meter into the vessel, taking care not to rest the probe on the base of the container
3. Allow time for the reading on the display to stabilise then record the value on the data sheet, making sure to include the units of measurement as well in the 'Units' column.
4. Turn off the meter and rinse the probe in distilled water. Do not wipe the probe as this may damage them.
5. Replace the protective cap on the meter and return it to the kit.
6. Retain the water sample and repeat the conductivity measurement using the Horiba water quality probe..

Figure 4. Hori water meter with Electrical conductivity probe.

4.4 Testing pH

You will need:

- Latex gloves
- pH paper (Fig. 5)
- small plastic beaker
- Horiba U-10 water meter
- Waste container

Figure 5. pH paper

4.4.1 Procedure

1. Follow protocol on how to collect a water sample.
2. Using gloves, place a pH test strip in the water sample and leave it for five seconds.
3. Remove the test strip and place it against the colour comparison chart, matching the colour on the strip against those on the chart. Get your partner to do the same and verify the result.
4. Record the value of the pH reading to the nearest 0.5 pH unit on the field sheet.
5. Dispose of the used pH strip in the waste container.
6. Retain the water sample and repeat the pH measurement using the Horiba water quality probe.

4.5 Temperature

You will need:

- Thermometer (Fig. 6)
- Small plastic beaker
- Horiba U-10 water meter

Figure 6. Thermometer

4.5.1 Procedure

1. Follow protocol on how to collect a water sample.
2. Dip the thermometer into the beaker, taking care not to rest the thermometer on the base of the container.
3. Record the temperature on the data sheet provided straight away.
4. Retain the water sample and repeat the temperature measurement using the Horiba water quality probe.

To ensure for safe preparation of samples the following guidelines are to be met:

- Wear non-powdered latex gloves during sampling.
- Do not touch any part of sampling equipment that comes into contact with the sample such as the rim and lids of sample bottles.
- By rinsing equipment (sample bottles and syringes) with sample water three times, the risk of contamination is minimised.
- Do not drink or eat anywhere near samples or sampling equipment.
- Ensure all equipment is clear of dirt and debris.
- Leave bottle lids facing up when not screwed on the bottle.
- Make sure your hands are clean.
- Do not store food and drink in the same esky as samples.

5. Nutrient sampling

5.1 Preparation prior to sampling for nutrients

Contamination of samples can occur if sampling equipment or the samples themselves are not handled carefully. This leads to unreliable results that can't be used. This is especially important for nutrient sampling.

Note: When equipment is sealed in a packet (such as a filter), only open at the time you are going to use it. When opening a sealed packet, ensure that you open it at the handle end and make sure the sampling end does not come into contact with anything other than the sample or other clean equipment.

You will need:

- Filtration syringe (Fig. 7)
- 0.45 µm Minisart filter papers
- 3 x 30 millilitre sample vials for nutrients
- Labels for sample bottles
- Esky and ice for storing nutrient samples

Figure 7. Filtration syringes

5.1.1 Procedure

1. Follow protocol on how to collect a water sample.
2. Rinse the syringe with water from the sample bottle three times. Avoid submerging hands into the water.
3. Shake the water in the sample bottle to ensure nothing has settled out.
4. Withdraw ~25 millilitre of water in the syringe and fill the 30 millilitre vial labelled ‘unfiltered’.
5. Refill the syringe and carefully screw a new filter to the end of the syringe. Discard a small amount of sample to rinse the filter.
6. Fill the vial marked ‘filtered’ with the 25 millilitre filtered water from the syringe. The water should flow with moderate pressure on the syringe plunger. If the filter becomes blocked (e.g. during windy conditions when the water is very turbid) change to a new filter. Never force the water through the filter.
7. Repeat steps five and six so that you have two vials marked filtered.
8. Cap each vial as they are filled and place into their respective place in the vial rack. Place the rack back into the esky. There should be a total of three vials.
9. Label samples, fill out data sheet and freeze vials as soon as possible.

5.2 Biofilm growth: strip test

Biofilms are an important source of food for grazers such as snails and many insect larvae (Fig. 8). The growth rate of biofilms on the surfaces of rocks, sand, wood and plants in the stream will be affected amongst other factors, by water temperature and available nutrients. Here, you will estimate the level of biofilm activity using test strips that have been pre-weighed and left in the water for a fortnight before you arrived.

5.2.1 Materials

- Pre-weighed strips of waterproof paper (dimensions: 15 x 1 centimetres)
- Electronic weighing balance
- Plastic cliplock bags for storing biofilm strips
- Forceps and small scissors
- Waterproof marker pen for labelling

Figure 8. Native snail feeding on biofilm.

5.2.2 Procedure

1. Locate the biofilm strips that have been fastened to wooden stakes inserted into the stream at the site (Fig. 9). Each strip is marked with an identification number.
2. Carefully remove the strips using forceps by cutting the plastic tie that holds the strip to the stake.
3. Place the strips in a plastic bag labelled with the site name and strip number and seal it. Place the sample in the esky.

Figure 9. Placing biofilm strips at Wambelong Creek site 3

5.2.3 Determining the mass of biofilm development on the plastic strips

1. In the laboratory, remove the strip and write down its strip number on the data sheet, place on a petri dish and allow it to air dry for 20 minutes.
2. Place a plastic petri dish on the balance and press the 'zero' key. The reading on the scales should be reset to zero.
3. Place the dry biofilm strip in the petri dish using the forceps and record its weight on the data sheet. Obtain the pre-immersion weight of the strip from your teacher and record this on the data sheet as well.
4. Determine the weight difference of the strip since it was placed in the stream. This is the biomass of the biofilm that has developed on the strip since it was immersed in the stream.

The mass of the biofilm can be standardised by the area of the strip (strip area = 147.5 cm^2) and the number of days that it has been left in the field.

5.3 Measuring water quality using the Horiba Water Quality Meter

The Horiba meter measures:

- Conductivity
- pH
- Water temperature

In this exercise we are duplicating some of the measurements described above to see whether systematic differences exist between the values recorded from the above tests and those measured with the Horiba meter.

Figure 10. Wambelong Creek Site 1

5.3.1 Procedure

1. Turn the Horiba U-10 on by pressing the POWER key on the keypad and allow it to warm up for 1 minute. Make sure that you remove the protective cap from the pH electrode before use. The display should be in the MEAS mode.
2. Place the probe in the water sample
3. Press the SELECT key move the upper cursor to the water quality parameter result that you wish to record (Fig. 12). The probe will need to be moved slowly up and down to circulate water over the sensors in order to stabilise the reading for pH and DO.
4. Record the result for pH, COND and TEMP on the data sheet. Don't forget to include the units of measurement (right-hand side of the display).

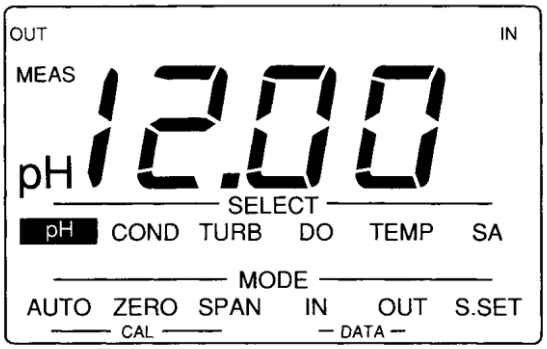

Figure 11. The readout on the Horiba LCD readout screen should be similar to this. Here the readout is for pH (note how pH is highlighted in black). The units of measurement will be shown on the right-hand side of the screen for the other parameters.

Note that pressing the 'EXP' key will change the precision of the parameter readings.

5.4 Caring for the Horiba U-10 meter

5.4.1 Procedure

1. Once you have finished with the Horiba meter turn the power off.
2. Rinse the probe with clean, distilled water to remove any traces of the sample water.

The small cap that fits over the pH sensor should be filled with tap or distilled water and replaced after use. The pH sensor should always be kept moist.

6. References

Horiba Instruction Manual (1991). Second edition, November 1991. Copyright 1991, Horiba Ltd.

Water quality data sheet

Site name:		
Date:		
Time:		
Observers:		
Rainfall in the past week: (none, light, moderate, heavy)		
Stream flow status: (dry, scattered pools, not flowing, low flow, moderate flow, high flow, flooding)		

Results

Nutrients samples collected? (tick): (total of three vials)

Unfiltered ☐

Filtered ☐

Filtered ☐

Parameter	Method	Result	Comments
Electrical conductivity (µS/cm)	Horiba		
	Conductivity Probe		
pH	Horiba		
	Indicator strip		
Water temperature (°C)	Horiba		
	Thermometer		
Biofilm growth strips Strip number:			