CONTENTS

INTRODUCTION

This **Waterwatch Victoria Methods Manual** contains a selection of methods for field monitoring equipment that is widely used across Victoria and Australia. The methods included are common parameters that are measured in the field by Waterwatchers. Included are:

- Temperature,
- Dissolved Oxygen,
- pH,
- Electrical Conductivity,
- Turbidity,
- Phosphorus,
- Nitrogen and
- Macroinvertebrates.

The methods listed are for a selection of equipment only and don't cover the entire range of field equipment available. Many of the portable field kits such as the colorimeters have their own manuals and it is important that you follow the methods supplied with such equipment. When purchasing any new equipment it is wise to read all the information supplied with that piece of equipment. Many of the instructions supplied with kits have special tips and general maintenance guides that will need to be followed to ensure the life of the equipment. It is important when testing in the field that methods are followed and equipment is calibrated, clean and in good working order.

This manual can therefore be used as a guide to develop basic regional methods manuals for groups to use when testing in the field.

When using this manual the following references contain a wealth of background information which may help in gaining a better understanding of each parameter;

- A Community Water Quality Monitoring Manual for Victoria
- Waterwatch Education Kit
- Waterwatch Equipment Manual

SAFETY

Field Safety

General points regarding field safety that should be taken into consideration while sampling and analysis is undertaken in the field.

- Check stream bank is stable and has easy access during all weather conditions to your site.
- Let someone else know how long and where you will be sampling.
- Wear proper clothing and footwear depending on weather, eg. hat, warm clothing and shoes with a good grip, etc.
- Do not allow children to sample or test without adult supervision.
- Use common sense when walking to and from site, i.e., beware of holes, snakes, prickly vegetation, etc.
- Do not put yourself or others at risk of falling into unknown water and beware of stream currents and undertows when sampling macro invertebrates, ie., do not let children undertake adult tasks.

Chemical Safety

- Read all warnings and procedures of first aid before chemicals are used and have them available if spills or accidents occur.
- Take care when handling chemicals. Always use the safety equipment provided and read the chemical labels when using the kits, i.e., safety gloves and glasses.
- Provide adult supervision when children are using chemicals and ensure they are educated about the dangers regarding chemicals and use appropriate safety equipment.
- Do not drink water from the source you are testing as it may be polluted. In particular when testing do not put your hands near your mouth or eat and drink while testing the water.
- When finished using the chemicals and testing is complete, ensure hands are washed thoroughly.
- All chemical waste used in water quality testing should be collected in a plastic bottle and disposed of correctly.

Field Considerations

- If entering a private property to reach your site, seek permission of the owners first.
- If crossing through fences do not damage the fence by climbing on the wires, crawl under them and remember to look out for electric fences.
- It is important to leave all gates as you found them, open or closed.
- Keep your site as clean as possible by removing excess rubbish.

Sample Collection

The sample collected should be representative of the water body being tested.

- Attempt to take the sample from about the middle of the stream or as far from the bank as possible. About the middle means half way between the sides and half way between the surface and the bottom. If the water is deep, take the sample from about 20cm below the surface.
- All sample bottles and buckets should be rinsed twice with stream water prior to collecting samples for testing.
- If collecting the sample while standing in the stream, always take the sample upstream of where you are standing to avoid disturbing the stream bed and releasing sediments.
- Do not take your sample from:

  - non-flowing water near the stream edge

  - the surface of the water.
- Direct sunlight can affect samples so store and perform all chemical tests in the shade.
- Fill sample bottle completely to prevent any loss of dissolved gases.
- Label all samples immediately on collection with site name or number, date and time of sampling.
- Do not place anyone in a situation where an accident may occur, use common sense when collecting samples.

Sample Preservation and Storage

All water samples should be tested as soon as possible after collection. If analysis is delayed, changes due to biological activity, physical changes or chemical reactions can be prevented by:

- Filling to top of container before capping to prevent loss of dissolved gases.
- Storing sample in darkness to stop photosynthesis.
- Cooling the sample to reduce biological and chemical reactions.

N.B.: If the weather is poor and the sample is to be taken back to the classroom, house, etc., when collecting sample fill to the very top and cap underwater if possible. Take thermometer to the site so temperature can be measured straight away. If there is a long delay between sampling and analysis, (>2 hours), store sample in a cool, dark container, eg. esky.

Recommended sample storage and preservation techniques

Parameter	Container	Preservation	Maximum Storage Time
Conductivity	P,G	Refrigerate	28 days
pH	P,G	Analyse immediately	2 hrs
Turbidity	P,G	Analyse immediately or store in dark for 24hrs	24hrs
Temperature	P,G	Analyse immediately	no storage
D.O	G	Analyse immediately or "fix" sample	8 hrs
Nitrogen	P,G	ASAP or refrigerate	48 hrs
Phosphorus with 1+1 HNO_3	G rinsed	Refrigerate	48 hrs

G = glass
P = plastic (polythene or equivalent)

WATER QUALITY PROCEDURES

1. Water Temperature

Water temperature plays a very important role in the health and quality of a water body. Temperature can affect the biological, chemical and physical features of a river. The amount of oxygen that can be dissolved in water, the rate of photosynthesis by plants and algae and also the sensitivity of aquatic organisms to toxic wastes and disease can all be influenced by water temperature.

Method

Equipment

- LaMotte guarded thermometer
- Or any other type of non toxic liquid filled thermometer

Safety

Care should be taken with the glass thermometer

Procedure

1. Collect sample from stream.
2. Immediately place the thermometer in the sample and allow it to stabilise for at least 1 minute.
3. While the thermometer is still immersed take the reading.
4. Record the temperature as °C.

Calibration

- The thermometer should be calibrated yearly against a certified thermometer by a reputable laboratory.

Maintenance

- Keep the thermometer and guard free from dirt and other contaminants.
- Ensure glass does not get scratched.

2. Dissolved Oxygen

Dissolved Oxygen is essential for a healthy and diverse waterbody. Aquatic organisms and plants need oxygen to survive just as we do. Waters with consistently high dissolved oxygen levels (between 80 and 100%) are considered healthy and stable, capable of supporting a large variety of aquatic organisms. Dissolved oxygen in water mainly comes from the atmosphere. Waves, ripples and tumbling water mix with the oxygen in the air so that the oxygen dissolves in the water. Photosynthesis by algae and aquatic plants also produces oxygen for the water. In water bodies where there is extensive plant growth the dissolved oxygen levels can be monitored throughout the day and the effects of photosynthesis observed.

Safety

The procedures for dissolved oxygen require the use of potentially hazardous chemicals. If procedures are followed correctly and the necessary safety precautions carried out the risks are significantly reduced. It is important that when handling the chemicals the Material Safety Data Sheets (MSDS) are read and understood. These sheets also cover first aid measures if an accident occurs. Some of the chemicals used and some of the possible risks associated with them are listed below.

- **Manganous Sulphate** - A clear pink liquid that is soluble in water that may irritate the skin and eyes. First aid procedures for eye contact are to immediately flush with water for 15 minutes and for skin contact flush with water for 15 minutes and remove affected clothing and flush thoroughly. If needed consult a physician.

- **Alkaline Potassium Iodide Azide** - A clear colourless liquid that is soluble in water that can cause severe burns or may be fatal if swallowed (the concentration in this kit is quite low but should still be treated with caution).

- **Sulphuric Acid** - A colourless liquid that is soluble in water that can cause severe burns, ingestion may be fatal and inhalation can cause coughing, chest pains or damage to the lungs. The first aid procedures for skin and eye contact are the same as for Manganous Sulphate.

- **Sodium Thiosulphate** - A clear colourless liquid that is soluble in water that may be irritating to the skin. First aid procedures for eye contact are to flush with water for 15 minutes and for skin contact wash with soap and water.

Wear safety gloves and glasses at all times when handling these chemicals.

Method

Dissolved Oxygen – LaMotte D.O. Kit

Equipment

- Sample bottle with screw top lid
- Safety glasses and gloves
- D.O. kit and chemicals

Collection and Treatment of Water Sample

1. Rinse water sampling bottle with sample water.
2. Place bottle fully submerged in water (approx 10cm below surface) and allow the bottle to fill. When completely full tap sides to ensure no air bubbles are trapped and replace cap while bottle is still submerged.

   Note: The next two steps have to be completed **ASAP**.

   Wear gloves and glasses while conducting this test.
3. Add 8 drops of No.1 (Manganous Sulfate) and 8 drops of No. 2 (Alkaline Potassium Iodide Azide). Cap and invert several times. A precipitate will form. Allow this to settle below the shoulder of the bottle.
4. Add 8 drops of No.3 (Sulfuric Acid) and invert several times so that precipitate dissolves. (For kits using sulphamic acid powder, add one spoonful of powder to sample.)

   Following the completion of step 4, contact between the water sample and the atmosphere will not affect the test result.

Procedure

1. Fill the glass cylinder to the 20mL line with the collected “fixed” sample and cap.
2. Fill the direct reading titration syringe with No. 4 (Sodium Thiosulfate) being careful to remove all air bubbles. Invert the bottle and slowly withdraw the plunger, when the tip of the plunger is on zero, insert the syringe into the top of the glass cylinder.
3. While gently swirling the glass cylinder, slowly press the syringe plunger (add No.4 drop by drop) to titrate until the yellow/brown colour is reduced to a very faint yellow/straw colour.
4. Remove the syringe and cap. Be careful not to disturb the syringe plunger. Then add 8 drops of No.5 (Starch indicator). Sample should turn blue. If the sample does not turn blue you have added too much No.4, refill the titration tube with the fixed sample and titrate again.
5. Replace the cap and titration syringe. Continue titrating until the blue colour completely disappears, this may only take a few drops.
6. If the plunger tip reaches the bottom line before the end of titration, just refill the syringe (as in test procedure step No.2) and continue, Remember to include the first 10mg/L in your final result.
7. Record the results from the tip of the plunger, this is your result as mg/L. To convert the result to % saturation use the conversion monogram on page 8. Mark the water temperature on the top temperature scale. Then mark the D.O. level on the bottom mg/L scale. Connect the two points and where it crosses the % saturation scale this is your result as dissolved oxygen % saturation.

Method

Dissolved Oxygen - Hach Test Kit (for modified Winkler method)

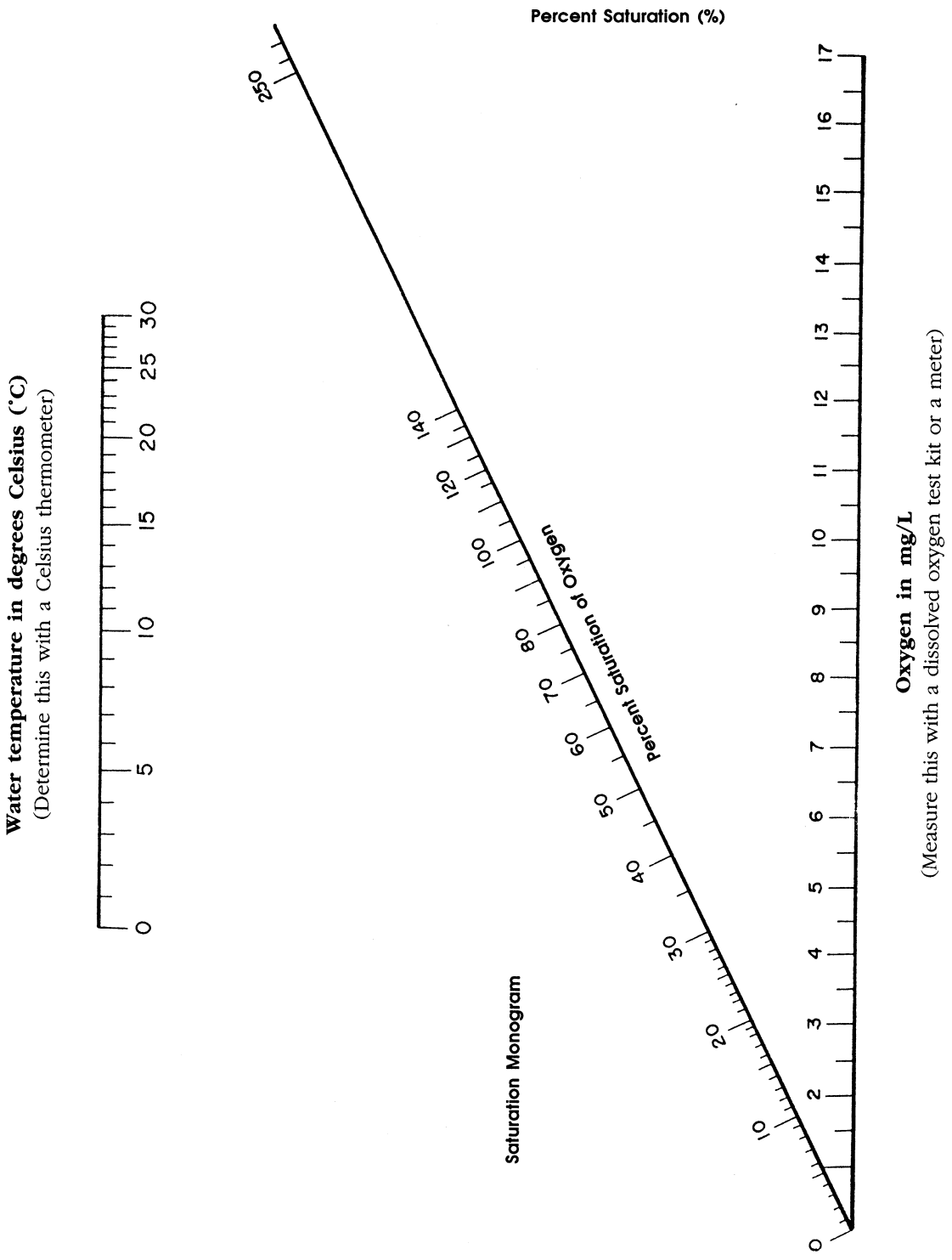
Equipment

- Safety glasses and gloves
- Stoppered glass bottle (rinsed with water to be tested)
- D.O. kit and chemicals

Procedure

1. Collect the water sample in a clean glass stoppered bottle. Fill the bottle by submerging the stoppered bottle in the water body and remove the stopper under the water. Restopper the bottle under the water when filled.
2. Add Dissolved Oxygen 1 Reagent Powder Pillow to the bottle. Insert the stopper gently without trapping any air bubbles. It may be necessary to top up the bottle with sample water.
3. Carefully add the contents of one Oxygen 2 Reagent Powder Pillow to the bottle. Replace the stopper carefully as above. Tip out any solution in the lip of the bottle.
4. Shake the bottle vigorously for one minute. A brownish orange precipitate should form if the water contains dissolved oxygen.
5. Allow the bottle to stand until the precipitate settles in the bottom half of the solution.
6. Remove the stopper and add contents of one Dissolved Oxygen 3 Reagent Powder Pillow. Restopper without trapping air and make up to the lip with sample if necessary.
7. Shake the bottle to mix. The precipitate will dissolve and a yellow colour will develop.
8. Fill the 6mL plastic measuring tube and pour this volume into the square titration bottle.
9. Fill the dropper with standard Sodium Thiosulphate solution. While holding the dropper vertically, add the solution drop by drop to the mixing bottle swirling to mix after each drop. Count the number of drops required to change the sample solution from yellow to colourless against a white background.
10. Concentration of Dissolved Oxygen (mg/L) = number of drops required.
11. To convert the result to % saturation use the conversion monogram on page 8. Mark the water temperature on the top temperature scale. Then mark the D.O level on the bottom mg/L scale. Connect the two points and where it crosses the % saturation scale this is your result as dissolved oxygen % saturation.

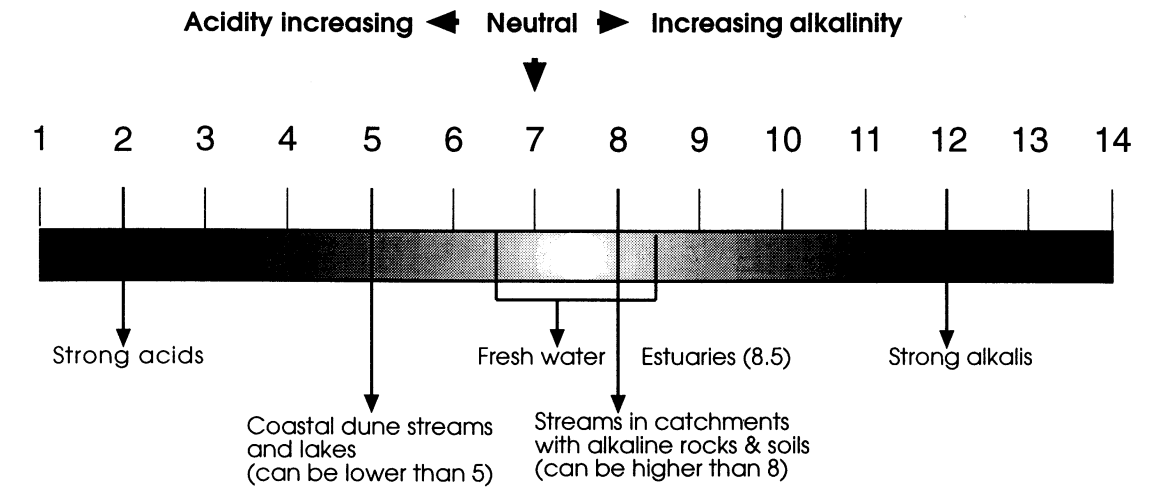
Dissolved Oxygen Saturation Monogram



3. pH

When we measure pH we measure how acidic or alkaline the water is. pH is a measure of the hydrogen ion (H+) concentration. The pH scale is from 1-14, pH of 7 is neutral, zero is the most acidic and 14 is the most alkaline. Animals and plants are very sensitive to changes in pH. A solution with a pH between 0 and 7 contains more H+ ions than OH- ions and a pH between 7 and 14 the solution contains more OH- ions than H+ ions. When a pH value changes by a unit of 1, eg. from 6 to 5, this equals a change in strength by 10 times. So a pH of 5 is 10 times more acidic than pH of 6, a pH of 4 is 100 times more acidic than the pH of 6. With alkaline substances it is the same, a pH of 14 is 10 times more alkaline than a pH of 13 and 100 times more alkaline than a pH of 12. So a large increase or decrease in pH outside the normal range of a stream will have a dramatic effect on the number and diversity of species found within the waterbody. To maintain a healthy diversity of life, pH must be kept within range of the natural variation for the waterbody.

The pH Scale



Method

pH – LaMotte pHscan2 and pHscanWP

Equipment

- pH Buffers 7 and 4 or 10 in film canisters
- pH meter and batteries
- Tap water

Calibration

1. Remove protective cap and turn meter on.
2. Dip electrode into pH 7 Buffer Solution then press “CAL” button.
3. Meter will then flash. Once reading has stabilised press the “HOLD/CON” button to confirm result.
4. Rinse the electrode with tap water or remove excess buffer with tissue.
5. Dip electrode into pH 4 or 10 buffer solution (use 4 if testing slightly acidic waters or 10 if slightly alkaline) and press “CAL” button.
6. Meter will then flash. Once reading has stabilised press the “HOLD/CON” button to confirm result.
7. Rinse the electrode with tap water or remove excess buffer with tissue. Meter is now ready for use.

Procedure

1. After the calibration step has been performed, place meter in waterbody or sample collected and continuously swirl meter. (Do not submerge pH meter below the black colour band if using a pHscan2.)
2. Allow the display to stabilise, if you want reading to freeze press the “HOLD/CON” button, press again to release it.
3. Record the reading.

Maintenance

Storage - When all readings have been taken, rinse electrode with tap water and place pH probe in film canister allowing it to soak in pH Buffer 7 until next use. Before next use remove the pH meter and soak in tap water over night. This will prolong the life of the meter.

Electrode - The glass probe on the pH meter is very sensitive and needs to be well maintained for the meter to produce accurate results. The following steps will help prolong the life of the meter if carried out on a regular basis (approx 3-4 times/year).

- Step 1: Place the meter in a beaker with enough 10% Hydrochloric acid (HCL) to cover the probe only, allow the probe to soak in the acid for 1-2 minutes only. Remove and rinse thoroughly with tap water.
- Step 2: Place a few drops of Methylated spirits on a soft tissue and **gently** wipe the glass probe clean, be careful not to touch the probe. Rinse the probe thoroughly with tap water.

Error Messages

E1- needs new batteries **E2**- incorrect buffer or electrode contamination

Method

pH - Indicator paper, Merck pH indicator paper

Equipment

- pH indicator strips
- Colour comparison chart

Procedure

1. Collect sample in a clean beaker or bucket.
2. Place indicator strip in sample and allow to sit for at least five minutes or until there is no further colour change.
3. Remove indicator strip from sample.
4. While moist, compare colour strip with chart on indicator packet.

Maintenance

- Store pH indicator strips in a dry moist free area and when using pH strips ensure the indicator packet is kept dry.
- Indicator strips have a shelf life of 3 years.
- Merck pH strips are “non bleeding”, that is none of the indicator substances on the strip contaminate the sample being tested.

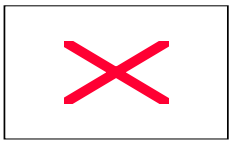
4. *Electrical Conductivity*

Conductivity measures the amount of dissolved ions such as, Calcium, Magnesium, Potassium, Chlorides and Bicarbonates that are present in a waterbody. It is measured by placing a conductivity probe in the sample and measuring the flow of electricity between the electrodes.

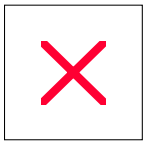
Conductivity is reported as EC units and the units used are usually given as microsiemens per centimetre (µS/cm). Conductivity is sometimes easily confused with salinity (units for salinity are mg/L). When you measure EC you are not doing salinity but a salinity result can be estimated by multiplying the EC result by 0.64.

Salinity problems occur when deep rooted vegetation is removed from the surface and through irrigation practices. What occurs is that much more water can infiltrate the soil and causes the water table to rise. The water can move towards the surface, bringing with it large amounts of salt from underground storage. After the water evaporates, high concentrations of salt remain which can eventually find its way into waterways. Many aquatic species can survive only within certain salinity ranges so changes in salinity levels may result in changes to the variety and types of species present.

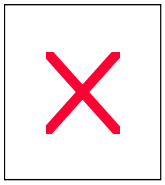
Variation in conductivity can result through changes in geology of an area such as Basalt plains. It can also be due to seepage of groundwater, industrial and agricultural effluent, stormwater runoff and sewage effluent flowing into streams.



Upper conductivity limit for dairy cattle is approx 9400 µS/cm



Upper conductivity limit for tomatoes is approx 2750 µS/cm



Common upper conductivity limit for humans is approx 2350 µS/cm

Method

Electrical Conductivity - TDScan3, TDScan4 or TDScanWP4

Equipment

- EC meter and batteries
- Standard calibration solution
- Jewellers screwdriver
- Distilled water

Calibration

1. Remove protective cap and turn meter on.
2. Dip the electrodes into the calibration solution and gently swirl meter. Do not immerse the TDScan3 or 4 meter above the coloured band.

   NB. The concentration of the calibration solution will depend on the expected range of sample water you are testing. If testing low level conductivities use a low range calibration standard (usually 1413 μS/cm) and a high standard if testing high range samples.
3. Once the reading has stabilised, if the meter is not displaying the correct value adjust with the screwdriver and the calibration screw. The calibration screw is located on the back of the TDScan meters and in the top of the TDScan waterproof meters.
4. Thoroughly rinse the electrode. The calibration of the meter should be done every month or more regularly if frequently used.

Procedure

1. Remove protective cap and place electrodes in sample.
2. Gently swirl the meter and wait for the display to stabilise.
3. Read the value, if units of meter are in millisiemens per centimeters (mS/cm) multiply the result by 1000 to convert to μS/cm.
4. Record the result.
5. Switch the meter off and rinse the electrodes with distilled water.

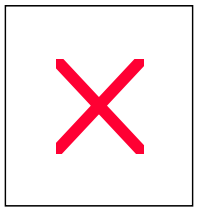
Maintenance

The stainless steel electrodes need to be kept clean and free from dirt etc, to ensure accurate readings are obtained periodic cleaning of the meter is required.

- In a beaker add enough Methylated spirits to cover the electrodes only. Place meter in beaker and allow to stand for 15-20 minutes. Once time has elapsed remove meter. With a soft tissue soaked in Methylated spirits gently wipe the electrodes. When finished wash thoroughly with distilled water.

5. Turbidity

Turbidity measures the clarity of the water. An increase in suspended matter increases the turbidity of the water. High turbidity causes water to appear murky or cloudy. Turbidity limits the amount of light able to penetrate through the water, which can effect plant growth by reducing the plants ability to produce food via photosynthesis. The suspended matter mainly consists of inorganic and organic material made up of algae, storm water runoff in urban areas and soil particles from erosion or the weathering of rocks. Soil erosion is a major input of sediments into a waterway. Removal of stream bank vegetation can mean soil is more easily washed into a waterway causing erosion and an increase in turbidity. Live stock using stream banks as access to water can also contribute sediments through erosion. Limiting stock access by fences can reduce the amount of bank erosion inturn reducing sediment input. Waste discharge through urban runoff can wash sediments off roads and drains increasing turbidity. High algal growth can also led to an increase in turbidity, as can an abundance of destructive bottom feeders such as carp.



Revegetation of verges and eroded banks can help reduce the amount of sediments entering a waterway.

Method

Turbidity - Waterwatch Turbidity Tube

Equipment

- Turbidity Tube
- Bucket (clean) or 500 mL sample bottle (Polyethylene)

Procedure

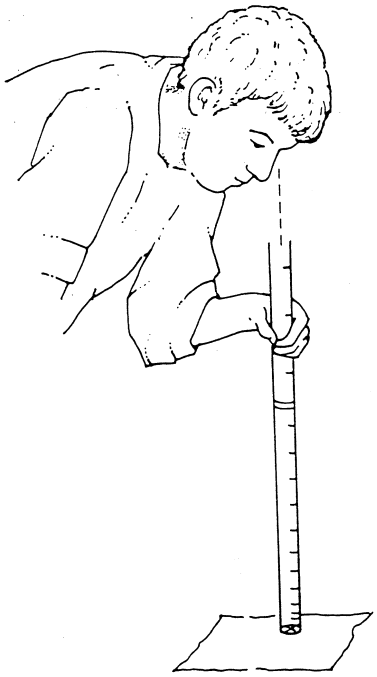
1. Collect sample in a clean bucket or sample bottle.
2. Ensure sample is well mixed before testing.
3. Gradually pour the sample into the turbidity tube while looking vertically down the tube (See picture below). Hold the tube out of direct sunlight during this procedure.
4. Stop pouring at the point where the black mark on the bottom of the tube is just visible.
5. Note the reading from the scale on the side of the tube.
6. Record the reading as NTU.

7. If the reading is above 200, dilute the sample 1:1 with distilled water. Repeat testing procedure and multiply the final result by 2.

8. If you fill the turbidity tube to the top or past the last reading and the black lines are still visible, take the reading as less than the last number, eg <10 NTU.

Maintenance

- Wash the turbidity tube thoroughly with tap water and ensure tube is kept clean and free from contamination.



6. Phosphorus

Phosphorus is a nutrient that occurs naturally at low concentrations in water and is essential for life. Phosphorus comes from the weathering of rocks and from the decomposition of organic matter such as plant litter. Phosphorus is present in streams as soluble phosphates, phosphorus bound to sediments and phosphates occurring in living organisms. Increases in phosphorus levels in streams may result from erosion, discharge of sewage, detergents, urban stormwater, rural runoff containing fertilizers and animal and plant material. Where there is an excessive amount of phosphorus in the water, algal blooms can be a serious problem. Blue-green algal blooms can have the potential to be extremely toxic to humans and live stock.

Phosphorus comes from a variety of sources including, human and animal wastes, industrial waste and disturbance of land and it's vegetation by natural or human influences. Sewage from treatment plants or industrial waste is one input of phosphorus into a waterway. Treatment plants must meet strict requirements for the concentration of phosphorus and other chemicals before being discharged into a water body. Storm water drains can be a source of phosphorus through illegal sewer connections or large amounts of animal wastes. The removal of natural vegetation can expose bare ground, which can then causes the phosphates contained within the soil to be washed into the waterway during rain periods. Fertilizers applied at the wrong time of the year can be washed away in much the same way.

Two different phosphate tests can be carried out to find the level of nutrient in water bodies:

- **Reactive Phosphorus** or **Orthophosphate** measures only soluble forms of phosphate and is indicative of the readily available and biologically active phosphorus. It has the advantage of being a simple test to carry out.
- **Total Phosphorus** includes all forms of phosphorus including particulate forms in unfiltered samples. The method requires an initial digestion to free phosphorus that is bound to soil particles.

Method

Reactive Phosphorus - Merck Aquaquant Kit

Equipment

- Safety gloves and glasses
- Distilled Water
- Filter paper Whatman No. 42 and funnel (If needed)

Procedure

1. Collect sample and if turbid filter sample through a No. 42 Whatman filter paper.
2. Open the pack and set up with both test tubes on you left.
3. Unfold the colour card and introduce it coloured end first into the slit at the lower right-hand end of the plastic box.
4. Pour 20mL of water sample into both test tubes.

   Caution: Wear safety gloves and glasses while undertaking this test.
5. Add 10 drops of Reagent P-1A into the sample tube closest to the tester and mix.
6. Add 1 level microspoon of reagent P-2A to same sample tube. Shake to dissolve.
7. Leave the solution to stand for two minutes to allow full colour development. If phosphorus is present sample will turn a shade of blue.
8. Slide the colour card through to the left until the closest possible colour match is achieved between the two open tubes viewed from above.
9. Read off the value shown on the scale at the upper right-hand edge of the plastic box. Note that there are two readings given. Record the number as mg/L P (phosphorus) and record in your result book. If the result is equal to zero record the result as < 0.015 mg/L.
10. If the value obtained is equal to or more intense than the darkest colour on the scale (0.14 mg/L), repeat the measurement on a fresh diluted sample, eg. Dilute the sample 1:5 by adding 10mL of sample to 40mL of distilled water in a 50mL measuring cylinder. Remember to multiply your answer by the dilution factor, in this case multiply by 5.
11. Repeat this dilution if the colour is still too intense.

    Note: The colour remains stable for about 30 minutes.

Maintenance

- Prior to testing ensure glass tubes have been thoroughly acid washed and rinsed with distilled water. This should be done before each new batch of testing to remove contaminants from the glass tubes.

Method

Total Phosphorus - Merck Oxisolve/Aquaquant Test Kit

Equipment

- Merck Aquaquant test kit range 0.015 – 0.14 mg/L P
- Merck Oxisolve 100 determinations cat No. 12936
- 2x 100mL conical flasks
- 50 mL measuring cylinder
- Filter funnel and Whatman No. 42 filter paper
- Distilled water
- Hot plate or heating source

Procedure

1. Shake collected sample to ensure a representative aliquot.
2. Using the 50mL measuring cylinder, add 50mL of sample to the 100mL conical flask.

   Note: It is good practice to run a blank sample through this testing procedure at the same time using distilled water. This will detect any contaminants present while testing.
3. Add 2 smoothed microspoons of Oxisolve to the conical flask.

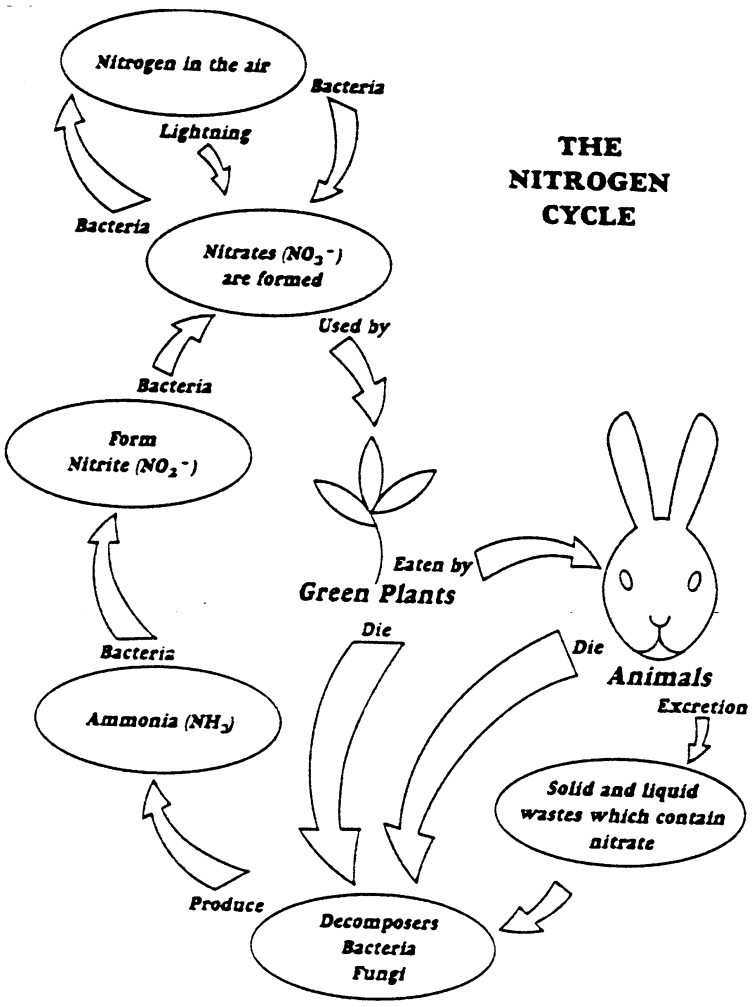
   Caution: Wear safety gloves and glasses while performing the digestion.
4. Boil the sample in the conical flask vigorously for 30 mins. Maintain the volume above approx 40mL with distilled water. After 30 mins allow the flasks to cool to room temp.
5. If the sample was turbid (> 15 NTU) filter through whatman No. 42 filter paper into the 50mL measuring cylinder. Ensure conical flask is rinsed with distilled water and then make sample up to 50ml with distilled water. If sample was low in turbidity sample can be directly transferred to 50mL measuring cylinder and made up to the mark with distilled water.
6. The sample is now ready for testing on the Merck Aquaquant test kit. Follow the previous method from step number 2 for analysis and the result is mg/L as P Total Phosphorus.

Maintenance

- Prior to testing ensure all glassware has been acid washed and rinsed with distilled water.

7. Nitrates

Nitrogen makes up about 80% of the air we breathe. It is an essential component of most biological processes. Inorganic nitrogen may exist in the free state as a gas, or as nitrites, nitrates or ammonia. Organic nitrogen is found in proteins and other compounds and represents a potential source of available Nitrogen, this organic nitrogen may be utilised by bacteria. Nitrites are relatively short lived because they are quickly converted to nitrates by bacteria. The delicate balance of an ecosystem can be upset when nitrogen concentrations become too high. Resulting problems can include algal blooms, loss of species diversity excessive growth of aquatic weeds. Natural levels of nitrogen in the form of nitrate and nitrite are usually low in rivers and streams (<0.75 mg/L total-N). Elevated levels can mostly be attributed to diffuse or point source pollution. As nitrates are soluble in water they are easily leached out of soil and washed into nearby waterways. Human activity in catchments such as forestry operations, land clearing, establishment of pastures carrying nitrogen-fixing legumes, use of nitrogenous fertilisers and release of nitrogen in industrial, sewage and urban wastes all may contribute to increased levels of nitrogen in waterways.



Method

Nitrate - LaMotte Nitrate Test Kit

Equipment

- Safety gloves and glasses
- Tissues
- Distilled Water

Procedure

1. Rinse the test tubes with the collected sample.
2. Fill tubes to the 5mL line with collected sample.

   Caution: Wear Safety Gloves and Glasses while performing this test.
3. Carefully add one Nitrate #1 tablet. Avoid touching tablet to prevent contamination. Cap and mix until the tablet dissolves.
4. Carefully add one Nitrate #2 tablet. Avoid touching tablet to prevent contamination. Cap and mix until the tablet dissolves.
5. Wait 5 minutes for reaction time.
6. Insert the colour slide into the viewer.
7. Wipe the sides of the tube with a tissue and insert into the viewer.
8. Match the sample colour to the colour standard by sliding the colour bar through the viewer.

   Note: The viewer should be held so that non-direct light enters the back of the viewer.
9. Record the reading as mg/L Nitrate-nitrogen. To convert to nitrate mg/L multiply the reading by 4.4.

Maintenance

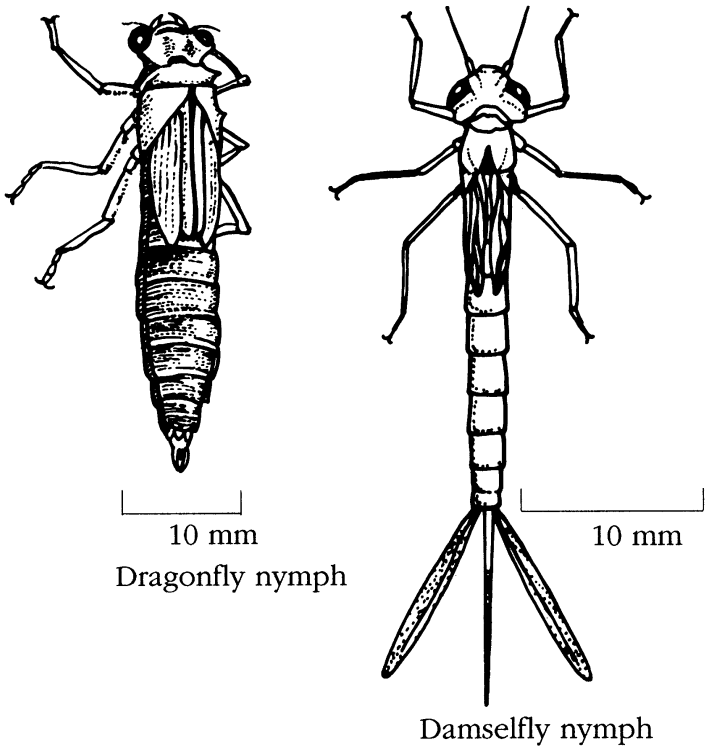
- Always keep the coloured sections free from dirt and dust.
- Ensure test tubes are thoroughly acid washed and rinsed with distilled water.

8. Macroinvertebrates

Macroinvertebrates are useful indicators of stream health because they occupy a central role in the food chains of aquatic systems, many live in the water for over a year, they cannot easily escape pollution (as some fish can) and they are sensitive to even quite mild pollutants or changes in water quality. They are also relatively easy and inexpensive to sample.

The variety and number of macroinvertebrates found in a water body can be used to indicate the presence of pollution. Chemical testing can then be conducted to confirm the presence and particular type of pollution. Macroinvertebrate sampling complements chemical sampling because it can detect the presence of most environmental stresses and may provide general indications about the type of pollutant. By contrast, chemical and physical tests are highly specific (for example, a test for pH or one for soluble phosphate levels). If the pollutant is not measured by one of the chemical or physical tests conducted at the site then it may go undetected if you only conduct these tests.

Furthermore, macroinvertebrates' life span of up to a year, together with their relative lack of mobility, can make them useful indicators of intermittent pollution. For example, a 'slug' of toxic waste released into a stream after an accident may have an impact on the variety and numbers of the macroinvertebrate community that remains evident for several months. By contrast, chemical monitoring, unless conducted when the toxicant is present, is far less likely to detect the event.



Method

Kick Sampling

This gently disturbs the animals living in or on the rocky bottom of the water source and allows the current to sweep them into the net.

Equipment

- Kick sampling net
- Tweezers and plastic suckers
- White plastic sorting tray
- Ice cube tray
- Magnifying glass to help with identification
- Reference books

Procedure

1. Select a shallow fast-moving area (riffle) with a depth of 10-30cm and stones that are cobble-sized if possible. Be extremely careful when entering the stream.
2. Place the kick sampling net at the downstream edge of the riffle so that the current flows through it. Be sure the bottom of it fits tightly against the streambed. You may want to use rocks to hold the net down so no organisms can escape under it. Also, do not allow any water to flow over the top of the screen, this too could allow organisms to escape.
3. To collect the sample, disturb the streambed for a distance of 1 metre upstream of the kick sampling net by vigorously kicking the mud and stones around your feet for a couple of minutes. The water current will sweep dislodged invertebrates into the net.

   Note: If you turn over any large stones, turn them back again after sampling.
4. Use a forward scooping motion to lift the net from the water. The idea is to remove the net without allowing any insects to escape from the surface.
5. Gently empty its contents into a white tray for sorting.
6. Sort through the sample and collect one of each different macro-invertebrate observed and place into the ice cube tray. Once you have finished sorting, use the reference books for identification and estimate the number of each macro-invertebrate. Fill out the macro-invertebrate record sheet and determine the water quality ranking.
7. Rinse the net so that all the animals and debris are removed before taking another sample and return all collected macroinvertebrates to the water.

Method

Sweep Sampling

This method samples the organisms living in and around the vegetation and/or edges of water bodies. It can also be used to sample the beds of muddy-bottom streams. Muddy-bottom water sources usually have fewer types of macro-invertebrates because the habitat is less suitable. Rock-bottom streams provide good oxygen circulation in the water and adequate shelter for organisms. However, when rocks are absent, macro-invertebrates will attach to roots, logs and other submerged items. A D-frame net is designed to scoop up the organisms from muddy bottoms.

Equipment

- D-frame net
- Tweezers and plastic suckers
- White tray to empty samples into for sorting
- Ice cube trays
- Magnifying glass to help with identification
- Reference books

Procedure

1. Using your net, vigorously sweep the water around the banks of the stream, sweeping around and through any vegetation or other material in this area. One method is to walk along the stream bank and scrape the surface of tree roots, gravel, leaf packs (piles of leaves) and other debris with the D-frame net. To do this, dip the net into the bottom while scooping it forward, making sure the first 10 cm of bottom material are disturbed. Continue the forward motion to lift up the net. Allow the water to drain and sort the sample. If this collects too much debris and leaves, an alternative would be to sweep the net back and forth over leaf packs, dislodging animals and some leaves, which would then be swept into the net.
2. To avoid gathering a net full of mud, you can pour water through the net to wash out some of the fine silt material before dumping the rest of the contents into a sorting tray for the identification.
3. Gently empty the contents of the net into a white tray for sorting.
4. Sort through the sample and collect one of each different macro-invertebrate observed and place into the ice cube tray. Once you have finished sorting, use the reference books for identification and estimate the number of each macro-invertebrate. Fill out the macro-invertebrate record sheet and determine the water quality ranking.
5. Rinse the net so that all the debris and macroinvertebrates are removed before taken another sample.

WATER QUALITY TABLE

The figures below are a guide for each of the water quality tests to help you interpret your results in terms of water quality.

Parameter	Excellent	Good	Fair	Poor	Degraded
Conductivity (μS/cm) mountain	<30	<90	<150	<225	>225
Conductivity (μS/cm) valley	<80	<240	<400	<600	>600
Conductivity (μS/cm) plain	<100	<250	<500	<750	>750
Turbidity (NTU) mountain	<5.0	<7.5	<10	<12.5	>12.5
Turbidity (NTU) valley	<10	<12.5	<15	<22.5	>22.5
Turbidity (NTU) plain	<15	<17.5	<20	<30	>30
pH	6.0 - 7.5	5.5 - 6 or <8.0	8.0 - 8.5	5.0 - 5.5 or 8.5 - 9.0	< 5.0 or > 9.0
Reactive Phosphorus (mg/L)	< 0.008	< 0.02	< 0.04	< 0.08	> 0.08
Total Phosphorus (mg/L)	< 0.01	< 0.025	< 0.05	< 0.10	> 0.10
Nitrates (mg/L)	< 0.05	< 0.1	< 0.2	< 0.4	> 0.4

FURTHER READING

The following references for each parameter contain useful background information:

Water Temperature

A Community Water Quality Monitoring Manual for Victoria
Physical and Chemical tests section, page 10
Waterwatch Education Kit
Student Information Sheet 12 C page 68
Information Sheet 7 page 69
Waterwatch Victoria Equipment Manual
Temperature page 6

Dissolved Oxygen

A Community Water Quality Monitoring Manual for Victoria
Physical and Chemical tests section, page 4
Waterwatch Education Kit
Teacher Sheet 12, page 62
Student Information Sheet 12A, page 63-64
Information Sheet 6, page 67
Waterwatch Victoria Equipment Manual
Dissolved Oxygen, page 13

pH

A Community Water Quality Monitoring Manual for Victoria
Physical and Chemical tests section, page 16-18
Waterwatch Victoria Equipment Manual
pH, page 11-12

Electrical Conductivity

A Community Water Quality Monitoring Manual for Victoria
Physical and Chemical tests section, page 14-15
Waterwatch Education Kit
Student sheet 2, page 9
Waterwatch Victoria Equipment Manual
Conductivity, page 9-10

Turbidity

A Community Water Quality Monitoring Manual for Victoria
Physical and Chemical tests section, page 12-13
Waterwatch Education Kit
Information Sheet 4, page 58
Teacher Sheet 10, page 55
Student Sheet 10, page 56-57
Waterwatch Victoria Equipment Manual
Turbidity, page 7-8

Phosphorus

A Community Water Quality Monitoring Manual for Victoria
Physical and Chemical tests section, pages 20-21
Waterwatch Education Kit
Teacher Sheet 11, pages 59-60
Student Sheet 11, page 61
Student Sheet 12B, page 65
Information Sheet 5, page 66
Waterwatch Victoria Equipment Guide
Phosphorus pages 15-19

Nitrates

A Community Water Quality Monitoring Manual for Victoria
Physical and Chemical tests section, pages 22-24
Waterwatch Education Kit
Teacher Sheet 11, page 60
Student Sheet 12B, page 65
Waterwatch Victoria Equipment Manual for Victoria
Nitrogen, pages 20-23

Macroinvertebrates

A Community Water Quality Monitoring Manual for Victoria
Biological Surveys section, pages 1-24
Waterwatch Education Kit
Teacher Sheet 9, pages 50-53
Information Sheet 3, page 54
Waterwatch Victoria Equipment Manual
Macroinvertebrates, pages 27-28