WATERWATCH
Victoria
Communities Caring for Catchments

WATERWATCH VICTORIA

DATA CONFIDENCE MANUAL

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ADDITIONS TO THIS MANUAL

New details and information can be forwarded to John McCoy, Science Co-ordinator, Waterwatch Victoria for inclusion in the next edition.

ACKNOWLEDGEMENTS

The Western Australia Ribbons of Blue Data Confidence Procedures were published in 1999. The National Waterwatch Data Confidence Guidelines were first published in 1999. Although the Statewide Office has been working on this guide since 1998, it has since included the basic framework provided by both the National and West Australian documents. This edition was compiled by John McCoy, Science Co-ordinator, Waterwatch Victoria, with help from David Hodgkins, Vera Lubczenko, Rebecca O'Kane and Jane Ryan.

ADDITIONAL REFERENCE MATERIALS SOURCED BY WATERWATCH VICTORIA

Kruger, T, Lubczenko, V (1994) ***A Community Water Quality Monitoring Manual for Victoria*** Victorian Community Water Quality Monitoring Task Group

Van Gameren, J (1997) ***Waterwatch Victoria Education Kit*** Waterwatch Victoria & Barwon Water

Department and Natural Resources and Environment -Waterway & Floodplain Unit (1999) ***An Index of Stream Condition: User's Manual*** Department and Natural Resources and Environment.

CONTENTS

INTRODUCTION

This **Waterwatch Victoria Data Confidence Manual** contains Quality Assurance/Quality Control guidelines (referred to as QA/QC in this report) for developing and carrying out a successful regional Data Confidence Plan. These guidelines are developed to help Waterwatch coordinators and monitors gain confidence in the data that they produce. As community monitoring of water quality grows it is important that the purpose for monitoring is developed and the intended use of the data understood. QA/QC measures (see page 4 for definitions) provide a system for the data user to be confident about the methods and equipment of the monitors through documentation.

The development of Data Confidence Plans for the Waterwatch programme, has a variety of benefits at both a national and regional level. Confidence in Waterwatch data helps to:

- make our data more useful for natural resource management agencies
- maintains the image of Waterwatch 'filling in the gaps' of professionally collected data
- provides Waterwatch with the ability to seek sponsorship dollars.

A Data Confidence Plan should cover all facets of data collection including sampling, analysis, data management and storage. This ensures the integrity of the data. It is very difficult to interpret collected water quality data when you are unsure of the quality of the data and actions by local authorities to address water issues can be costly in terms of money, time and credibility. If Waterwatch can document the care taken in collection of relevant data it will ensure that data is of the highest standard with greatest credibility.

Adding QA/QC measures to your regional monitoring programme has a number of benefits if data quality is the prime concern. These measures allow you to:

- identify contamination of samples, inadequate practices and procedures, and failure of equipment. It also highlights correct results, and the use of standard procedures.
- produce data of known integrity, which will increase the data value to all users.
- maintain and increase support from natural resource management agencies and other sponsors.
- save money and time, reducing the need to resample or discard data.
- demonstrate good scientific principles and instil confidence into monitoring groups in the field.

Developing your own Data Confidence Plan does take time and money to develop but ultimately, it will provide a successful and smooth operating programme in the future. This manual provides the framework for the development of your own plan at regional/local level to suit your programme.

This manual should be used in conjunction with the Victorian Waterwatch Equipment Manual and the Victorian Waterwatch Methods Manual.

WHAT IS QUALITY ASSURANCE?

Quality Assurance *is an integrated system of activities to ensure that data meets defined standards. These activities include quality planning, control, assessment, reporting and improvement.*

Aspects of a QA programme include standard operating procedures for each parameter (found in the **Waterwatch Victoria Methods Manual)**, calibration procedures, documentation, training, equipment servicing, evaluation, reporting and quality control.

WHAT IS QUALITY CONTROL?

Quality Control *is the system of activities whose purpose is to measure and control the quality of data.*

It is the specific steps taken during sample collection and analysis to ensure data collected is both accurate and precise. A quality control programme is designed to suit the plans of a monitoring group and can include analysis of mystery samples, analysis of blank samples, calibration of meters against known standards, analysis of duplicates and recovery of known additions.

The main indicators of data quality are precision and bias which, when combined express its accuracy. ***Precision*** *measures the closeness of with which multiple analyses of a sample agree with each other.* Precision is assessed by repeated analyses of a stable standard and then specified through statistical analysis of the data, for example standard deviation.

Bias *is a measure of systematic error*. It can be associated with either the method and/or the operators' use of the method. See figure 1 for an explanation of the relationship between precision, bias and accuracy.

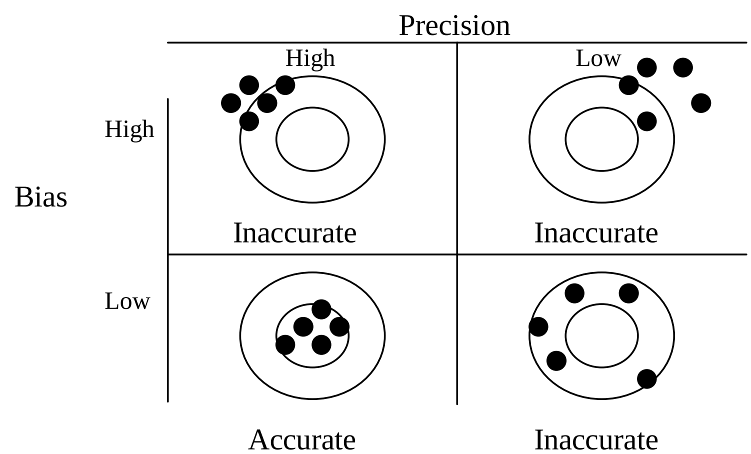

Figure 1. Precision/ bias chart (Source: Geoff Dates, River Watch Network)

KEY ELEMENTS OF QA/QC

There are 5 key elements that the Waterwatch Australia Steering Committee has highlighted as integral parts of any data confidence plan. These elements are not stand alone, and are in no particular order - some areas necessarily encompass components of others. The five areas are:

DESIGNING A MONITORING PROGRAMME - WHY MONITOR?

Designing a monitoring plan provides a broad overarching QA structure. This section addresses the need for groups to prepare a monitoring plan so that the right information gets collected and the monitoring meets the desired outcomes for data use. A monitoring plan is important to data confidence because we want to ensure we have the data to answer the questions we are asking.

SAMPLING AND MEASUREMENT TECHNIQUES - HOW TO MONITOR?

Sampling and measurement techniques provide the nuts and bolts of the QC procedures. This section considers the methods and the tools used to monitor, and addresses the ways to reduce risk of error. It will cover the necessary QC checks needed for each parameter tested. This section will not go into specific procedures or equipment, as these are covered in the **Victorian Waterwatch Methods and Equipment Manuals**.

DATA VALIDATION AND MANAGEMENT - HOW TO MANAGE DATA?

The checks suggested under data validation and management along with the prompts in the Waterwatch Database reinforce the previous elements. Compliance to Waterwatch QC procedures ensures that the Waterwatch database is a credible repository for community data, and maximises its usefulness.

TRAINING - WHAT SKILLS ARE REQUIRED?

Training suggests some more qualitative steps to ensure the other components of the data confidence plan are implemented effectively. This section considers the skills and knowledge that regional coordinators require in order to support group monitoring projects, and that monitoring groups require in order to implement monitoring programmes.

RECORD KEEPING - WHAT RECORDS TO KEEP?

Through record keeping, all the QC components are documented ensuring a defined level of data confidence. Accurate records are fundamental to data confidence as they allow data users to verify information.

Each of these elements will be covered in detail and by considering these five elements, regional programmes will have developed their own Data Confidence Plan necessary for successful Waterwatch groups. It is important not to forget that data collection is not the only purpose of Waterwatch. Water monitoring and generation of subsequent data is simply the tool to engage the broader community in catchment management. The data we have in the database needs to be of known quality, **but the programme is not driven by the pursuit of data.**

DESIGNING A MONITORING PROGRAMME

Monitoring plans are developed to ensure that Waterwatch coordinators and monitors are:

- asking the right questions
- collecting accurate and precise data that meets the requirements of the data users
- reporting the data in an informative manner
- using available time and resources efficiently.

A monitoring plan is the first key step in establishing a set of operating principles for a Data Confidence Plan. A monitoring plan is easy to work through and helps groups to identify key aspects and set achievable targets.

A monitoring plan is based around eleven basic questions and will benefit any monitoring group. The depth and extent to which the plan is developed depends upon the intended purpose of monitoring. The eleven questions are briefly discussed below with greater detail outlined in each relevant key element section.

i)Why are you monitoring? ii) Who will use the information? iii) How will the information be used?

These questions will establish the base of a monitoring plan. The first step in developing a plan is identifying the purpose for monitoring. Different Waterwatch groups have different reasons for monitoring, and information needs should drive the design of a monitoring plan.

The “why” question will help determine the extent of how detailed the monitoring plan needs to be developed and also guide the necessary QA/QC measures that should be included in the plan. If the intent of the group is only to use the data for general education purpose, then the data accuracy is not as great a concern. Other groups such as Landcare, may be trying to assess the impacts of high nutrients, which will generally mean greater QA/QC checks throughout the monitoring plan.

It is important to identify who is going to use the data and how to link this data with potential users, whether they are community groups or local authorities.

iv) What will you monitor? v) What methods will you use? vi) How good do you want your data to be?

The parameters that you monitor will depend on both the available resources and skills as well as the previous stages of developing the monitoring programmeme. When you have decided what it is you are trying to achieve, it may be necessary to seek some expert advice on what should be monitored and the most suitable methods available. Remember that most methods and equipment used the available are covered in the Waterwatch manuals. The eventual use of the data will influence the quality of your data.

Data users should be involved in determining how good the data should be. If you require data of a high quality it is necessary to develop a strong Data Confidence Plan which includes all five key elements mentioned on the previous page. Good quality data are derived from surveys or tests samples that are complete, representative and comparable.

Completeness *refers to the amount of data required to meet the desired quality*. For example, if testing recreational waters for faecal bacteria, at least five samples are recommended.

Representativenes*s is the extent to which your data actually represent the conditions in the river, for example choosing the correct sampling site*. Comparable samples allow you to make valid comparisons of data. For example, macro-invertebrate results can be compared between one riffle site and another, but comparisons should not be made of a sample collected from edge water.

vii) Where will you monitor? viii) When will you monitor? ix)Who is going to be involved and how?

Where you monitor will depend, both on the purpose for monitoring, and the water body to be tested eg, lake, river, dam etc. It is important to choose a site that is representative of the water body being tested and the site can be reached during all conditions. When you monitor will be influenced by why you are monitoring and what information you are trying to collect. Knowing who is to be involved and what role can they play in the monitoring plan will affect the ‘when’ of monitoring. Often the resources available limit the size of a monitoring plan. Once you have decided who is going to be involved it is necessary to gauge current skills and training requirements.

x) How will the monitoring data be managed and presented?

It is assumed that all groups in Victoria will be using the Waterwatch database for all data storage. Before the data is stored on the database it is important that the data is screened for any questionable results and then entered onto the database if no problems are detected. Development of field data collection sheets is important so that the data is received on a standard record sheet and the information collected can not be confused. Presentation of data and interpretation of data will depend on the needs of the monitoring groups or the request of local government or authorities. This section will be discussed in more detail in the section on data validation and management (page 18).

xi) How will you ensure that your information is credible?

This area will vary and depend on the QA/QC measures put in place by regions and monitoring groups. The first step to ensure your information is credible is working through a monitoring plan and from that, developing the required QA/QC procedures to meet the monitoring needs. This area is covered in greater detail throughout these guidelines.

When developing a monitoring plan it is important to revisit previous question that have been answered. The reason why you are monitoring is the main area that should be focused on while developing the plan. If this basic question cannot be answered with the resources available it may be necessary to refocus on what it is you are trying to achieve.

The QA/QC aspects associated with a monitoring plan are the importance of documenting and distributing to anyone involved with the monitoring group. Waterwatch coordinators should endorse the plan after developing it with the group. It is good to revisit the plan every year or when significant change occurs, such as an approval of a grant or identification of a trouble spot on the waterway.

Communication is vital in the development of the monitoring plan. It is the co-ordinator's responsibility to ensure that the time required by the voluntary monitors is minimised (see appendix F as an example of a monitoring plan). All key groups and individuals should be documented with their responsibilities outlined and a system developed to address problems that may occur, for example during sample analysis.

SAMPLE COLLECTION AND MEASUREMENT TECHNIQUES

Correct sampling and measurement techniques are essential if data users are to have confidence in the quality of Waterwatch data. Data confidence requires that samples are representative, equipment is reliable within an agreed range, and Waterwatchers are sufficiently skilled in sampling method and use of equipment. It is in the area of sample collection and measurement that quality control procedures can be most effectively employed to reduce these sources of error.

The methods and safety aspects of sample collection (found **in Waterwatch Victorian Methods Manual**) form part of the QC procedures for sample collection and should be followed every time a sample is collected. Some additional points regarding QC procedures for sample collection are listed below.

SAMPLE COLLECTION QUALITY CONTROL

Monitors should be confident that:

- the sampling technique is appropriate for the parameter/s being tested and does not influence the measurement of those parameter/s.
- appropriate equipment is used for sampling and storage. For example; clean polyethylene bottles, glass bottles, esky etc.
- sampling equipment and containers are clean and free from contaminants.
- samples are taken in the same way and from the same location.
- appropriate sample preservation is undertaken if the analysis is not done in the field.
- samples are clearly identified with site code, description, date, time, sampler name, tests to be performed and any comments necessary if being stored or sent to a laboratory.
- sampler has been trained in sampling collection technique.

Large groups, such as school classes, often break into smaller groups and collect a number of samples from a monitoring site. If the samples are collected at the same site and time, the samples are known in QC terms as **field replicate samples**. If the sample is taken in one large container and a portion analysed by each group the sample is known as a **split sample**.

Samples being analysed by both a Waterwatch group and a laboratory should be a split sample. The split sample can work well in the classroom as an intra classroom QC check on different equipment and monitoring techniques. The field replicate samples are expected to have identical results when analysed correctly. Results can identify if there is a problem with sampling techniques or the method used.

When reporting on multiple results for the same sample, the median should be calculated and recorded as the result to be entered onto the database. The median calculates the mid point of a data set and excludes any outlying results. The following example shows us why the median is better to use than the average for such data sets.

EXAMPLE:

An Electrical Conductivity test from a local school's replicate sample had the following results from five different meters; 2200, 2250, 2100, 2200, 1200

The median equals 2200, the average equals 1990. It is clear that 1200 is an outlying result due to a faulty meter. This result does not effect the median value calculated but alerts the operators of a problem.

Other useful statistical methods for analysis of QC data include,

- Standard Deviation- used to compare how closely three or more results are clustered around the average value. The result is expressed as x ± S.D, where x = the average, S.D = calculated standard deviation. The smaller the standard deviation the more precise the results.
- Relative Standard Deviation- used to express the standard deviation as a percentage of the average to make it more meaningful. The lower the percentage the more precise the result.
- Relative Percent Difference- used to compare how close the sample result is to the true result. It is most often used when **'mystery sample'** test has been performed, or where a calibration solution has been analysed.

Another good way of assessing measurement techniques and equipment performance is the use of '**mystery samples**'. The samples are prepared and tested by a laboratory so that the true results are known, then sent out to coordinators and Waterwatch groups for analysis. The results are statistically assessed and outlying results addressed. The mystery samples can be used for chemical parameters and also macro-invertebrate identification and classification. This system is currently run at a State level for coordinators and can be developed by regions for monitoring group assessment.

SAMPLING AND MEASURING TECHNIQUES- pH

QA/QC METHODS

The methods adopted depend on whether a group is using pH indicator paper or a pH meter for sample analysis. pH meters require one or two point calibration on each sampling day and if large numbers of samples are being analysed, they should be checked for drift after every fifth sample against one of the pH buffers. This recheck should be within 0.1- 0.2 units (range depends on sensitivity of the meter) of the true value of the pH buffer. If the meter is out it will need re-calibration or may need to be serviced.

pH indicator paper can not be calibrated but the manufacturers instructions should be followed to ensure paper is being used and cared for correctly. Sample results obtained from pH paper should be compared with that of a calibrated meter to determine if they fall within a designated error range.

pH BUFFERS

There are a number of different types of pH buffers available, from tablets to commercially prepared pH solutions. Solutions have a shelf life of approximately 6 months to a year, depending on the manufacturer's instructions. Once opened the used portion should be replaced every month. The shelf life of pH tablets varies depending on the brand, but it is usually between 3-5 years. Once the pH tablet has been made into a working solution, the solution should be replaced every month. pH buffers may deteriorate over time due to mould growth or contamination. Replacing your buffers regularly will ensure your meter is working at its optimum.

pH METER SERVICING AND PREVENTATIVE MAINTENANCE

pH meters are very sensitive and need to be well looked after during testing and when in storage. Regular servicing of the meter can prolong its life, ultimately saving you money. Glass electrodes fail because of scratches, deterioration and accumulation of debris on the glass electrode. The electrode should be cleaned and maintained once a month (less if the meter is used infrequently). Carefully wipe the glass membrane with methylated spirits and a soft tissue to remove greases, then rinse the probe thoroughly with distilled water.

If further cleaning is required, soak the probe in 0.1M HCl (8.3mL/1000mL DI water) for 30 seconds, then rinse thoroughly with distilled water. It is important that when not in use, the meter is correctly stored to prevent the electrode from drying out. Most manufacturers' instructions recommend the probe be stored in tap water or pH 7 buffer solution.

SAMPLING & MEASUREMENT TECHNIQUES - CONDUCTIVITY

QA/QC METHODS

Conductivity is usually measured with an Electrical Conductivity (EC) Meter and the salinity value can be calculated from this result. The EC meter needs to be calibrated to a known standard solution on each monitoring occasion. The standard solution can be purchased or prepared by a laboratory.

The meter is calibrated to the standard that bests suits the EC range of the samples to be tested. If the samples being tested are around 4000-6000 µS/cm, the best standard to calibrate the meter against would be a 0.05M KCl standard. This standard has a value of 6667 µS/cm at 25°C. If your meter has a resolution of 100 µS/cm you would calibrate the same standard to 6700 µS/cm.

It is important that standards are kept stored in an airtight bottle and that unused portions are not returned to stock solution. The stock solution should be replaced once a year, with the portion used to calibrate the meter replaced every 3 months. The solution should be changed more often for a more regularly used meter. Table 1 below shows the range of KCl standard solutions available.

Table 1. KCL standard solutions

KCl Concentration (M)	g/L of KCl per 1000 mL DI water required	Conductivity of Standard (µS/cm)
0.01	0.7455	1412
0.02	1.491	2765
0.05	3.7275	6667
0.1	7.455	12890
0.2	14.91	24800
0.5	37.275	58670

EC METER SERVICING AND PREVENTATIVE MAINTENANCE

Most problems in obtaining good data with conductivity monitoring equipment are related to electrode fouling and inadequate sample circulation. After testing, keep the electrode free from contaminants by washing the electrode thoroughly with distilled water and wiping dry with tissue. To clean electrode, periodically wipe with a tissue and methylated spirits, then rinse with distilled water.

SAMPLING AND MEASURING TECHNIQUES-PHOSPHORUS

QA/QC METHODS

Very low concentrations of orthophosphorus and total phosphorus within waterbodies can be difficult to measure in the field. Cleanliness of all sampling and analysis equipment is essential. Phosphorus samples are easily contaminated and all glassware must be frequently acid washed to remove contaminants attached to the glassware.

Waterwatch groups generally use a colour comparative method for phosphorus analysis. Most of the equipment used in this method (for example, Merck Aquaquant), do not require calibration steps prior to use. Known standard phosphorus solutions can be used for assessing the analysis techniques, the accuracy of the reagents and equipment used. These standards can be purchased, and a local laboratory may provide a cheap option. Phosphorus standards should be stored at 4°C and last approximately one year.

Blank samples, such as distilled water, should be used to ascertain if there is any contamination or interference from either the equipment or the chemicals being used. It is important that the expiry date of the reagents in the kit is noted and that they are replaced when out of date.

If undertaking total phosphorus analysis it is good practice to run a blank sample (distilled water) with the samples being tested. Standard solutions should also be periodically run to ensure correct procedures are being used and to check accuracy and precision of the method. Photometers/Colorimeters often have there own guides for calibration steps. This information will be contained in the equipment's user manual. These steps usually include calibration with blanks, and the use of standard solutions for checks.

EQUIPMENT SERVICING

Dilute Hydrochloric acid (HCL) at approximately 10% is recommended as the best cleaning agent for glassware used in phosphorus determinations. If HCL is to be used to clean the glassware, it must be used with caution and all the associated safety precautions followed. Anyone using the acid should be trained and know first aid and spill procedures. The glassware should be cleaned quite regularly and this will vary depending on use. If a detergent is used, ensure that the detergent is phosphate free to avoid contamination. Once the equipment has been cleaned wash it thoroughly with distilled water.

It is important to keep the colour wheel or slide chart in good condition. The colour wheel should be free from dirt or marks over the colour guides and if the marks can not be removed or the slide chart has faded it is important that it is replaced as soon as possible. Lamination of colour charts in some kits may be useful.

NB if making a dilute Hydrochloric acid solution or any acid solution always remember; a*dd acid to the water slowly and continuously stir.* Wear gloves and glasses when handling any chemicals.

SAMPLING AND MEASURING TECHNIQUES - DISSOLVED OXYGEN

QA/QC METHODS

The most common method used by Waterwatch groups for monitoring dissolved oxygen is a modified Winkler titration technique. If a group has a Dissolved Oxygen (DO) meter they need to calibrate it every time it is used according to the manufacturers specifications. Most DO meters are calibrated in air so that they read 100% saturation and are usually checked in a laboratory against a standard Winkler titration. Care of the probe and membrane in particular is extremely important to ensure accurate readings are obtained.

There are no calibration steps or standard solutions available for the Winkler titration method field kit. If a DO meter is available and has been calibrated, it can be used on a split sample (see page 9) to compare results against the field kit. Solutions used for the titration should be checked to ensure they are still within their useable lifetime and that they are not contaminated.

EQUIPMENT SERVICING

It is especially important for the titration method or other methods used, to keep all glassware clean and thoroughly rinsed after each test. For DO meters the membrane needs to be regularly replaced and the electrolyte inside the probe kept at the correct level. For more information, refer to the DO meters' operational manual.

SAMPLING AND MEASURING TECHNIQUES- TURBIDITY

QA/QC METHODS AND SERVICING

Turbidity tubes are widely used throughout the Waterwatch programme and cannot be calibrated. They should be regularly cleaned and checked for scratches or defects. The use of field replicates (see page 9) is a good approach when assessing the turbidity of a waterbody. This requires the use of using a number of analysts, then calculating the median of the results.

Turbidity meters are calibrated against a calibration blank (distilled water) and a known standard of either formazin or gelex. The standards can also be used with the turbidity tube to assess analyst's bias and techniques. The tube is best cleaned with a test tube or pipe cleaner and detergent, this will remove build up of dirt on the walls of the tube.

SAMPLING AND MEASURING TECHNIQUES- TEMPERATURE

QA/QC METHODS AND SERVICING

Temperature has a major affect on water chemistry, as well as animals and plants, so it is important that accurate readings are obtained. In regards to water chemistry, high water temperatures causes an increase in measured salinity readings and a decrease in measured dissolved oxygen. It also causes some chemical reactions to speed up. The opposite is true for lower water temperatures.

Most groups use a non-toxic filled liquid thermometer for measuring temperature and these are generally very accurate. There is no calibration step needed for a thermometer but the standard method for calibration involves checking the thermometer (every 6 months) against a certified thermometer. These are expensive and usually only available from a NATA certified laboratory.

The thermometers are usually checked at two points; 0°C and within the working range of the thermometer. The field thermometer is then assessed for accuracy and if necessary a correction factor can be calculated. Thermometers should be regularly checked for cracks or defects.

SAMPLING AND MEASURING TECHNIQUES - MACRO-INVERTEBRATES

QA/QC METHODS

Macro-invertebrate identification skills develop over time. Valid macro-invertebrate sampling methods allow the level of identification that the monitoring group chooses, to be as simple or complex as they want. The ability of the samplers to accurately identify the macro-invertebrates will influence the level to which samples can be analysed. It is important that groups are trained in collection and identification techniques to a level that meets their monitoring needs. For example, some groups may require identification to family level for reporting purposes.

The standard sampling method (see **Waterwatch Victoria Methods Manual**) should be followed so that samples are consistently collected in the same manner. This ensures that variation over time at a site will not be due to incorrect sampling methods. When recording results, a standard data sheet should be used, whether its Waterwatch statewide or regionally developed.

Comparing a collected sample with a reference collection of identified macro-invertebrates collected by a local expert or lab, is invaluable as a QA procedure and can reduce time spent by the group on identification. As new macro-invertebrates are found they can be added to the reference collection helping to develop a complete library of regional macro-invertebrates.

When analysing samples it is important to only compare like samples collected with the same technique. For example, monitors should not compare sweep with kick samples, as they are completely different types of samples. Field replicates can also be very useful at a sampling site to check the ability to reproduce the sampling procedure.

EQUIPMENT MAINTENANCE

All equipment used for the collection, storage, sorting and analysis of macro-invertebrate samples needs to be clean and free of organic debris or leftovers from previous sampling sites. Nets used for the collection of macro-invertebrate samples need to be regularly checked for holes or tears, and repaired or replaced if necessary. The type of nets and sorting equipment used will vary depending on what the purpose of the sampling. Artificial substrate samplers need to be cleaned thoroughly prior to and after collection. If microscopes are used for identification purposes ensure that they have been calibrated to the manufactures instruction and regularly serviced to its specifications.

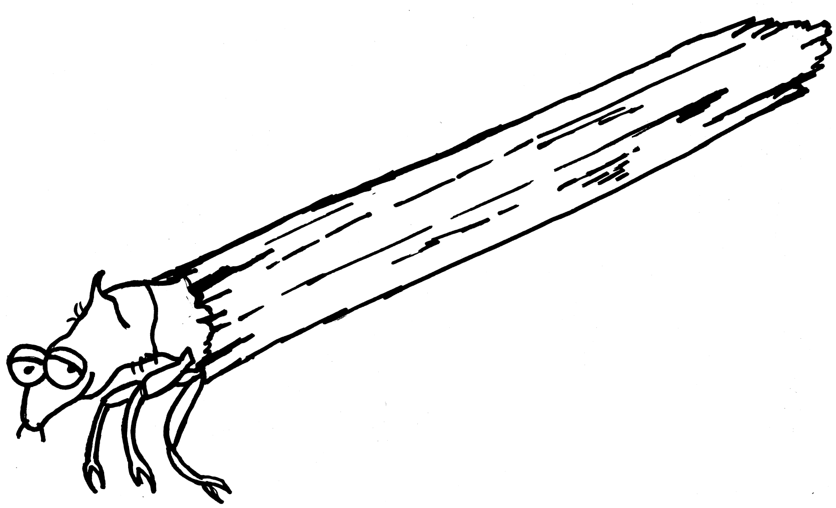

Figure 2 Caddisfly larvae. Source: Suzanna McCoy (1997)

SAMPLING AND MEASURING TECHNIQUES- HABITAT SURVEY

QA/QC METHODS

The aim of a habitat assessment is to gain an overall understanding of the health of the waterbody by examining the instream bank and verge conditions. The Waterwatch Stream Habitat method or the habitat assessment protocols defined by the Index of Stream Condition (Dept.of Natural Res. and Environment 1997) can be used as a standardised method for the assessment of habitat.

As habitat assessment is very subjective in its measurement, the assessment should rely on a scoring method for each aspect or portion of the habitat. The description for each aspect of the habitat is clearly defined. The use of site photos (see figure 3) as standard references will decrease the effect of sampler bias in the assessment.

One objective of the habitat assessment should be to obtain a score that can be compared against other sites. This not only helps to determine if one stream section is healthier than another, but also helps to document change at the one or several sites on the same stream. All results should be recorded on a standard reporting sheet and then entered onto the database.

Figure 3. Two sample reference photos for assessing habitat. Use of reference photos when assessing stream indicators is critical in keeping a standard method approach to habitat surveys. (Source: Waterwatch Victoria website.)

DATA VALIDATION AND MANAGEMENT

QA/QC METHODS

The collection of quality assured data is only one aspect of the Waterwatch programme. There is no point collecting data if it is not verified and stored correctly, or if no one ever uses the data. Verified data that is stored correctly, enables easy data analysis to show trends in waterbody health.

The verification and storage of the data should include some check of new data against either long-term data at the site, or normal expected ranges for a parameter. Before data is entered onto the database it should pass through a data management/validation system, as shown in figure 4.

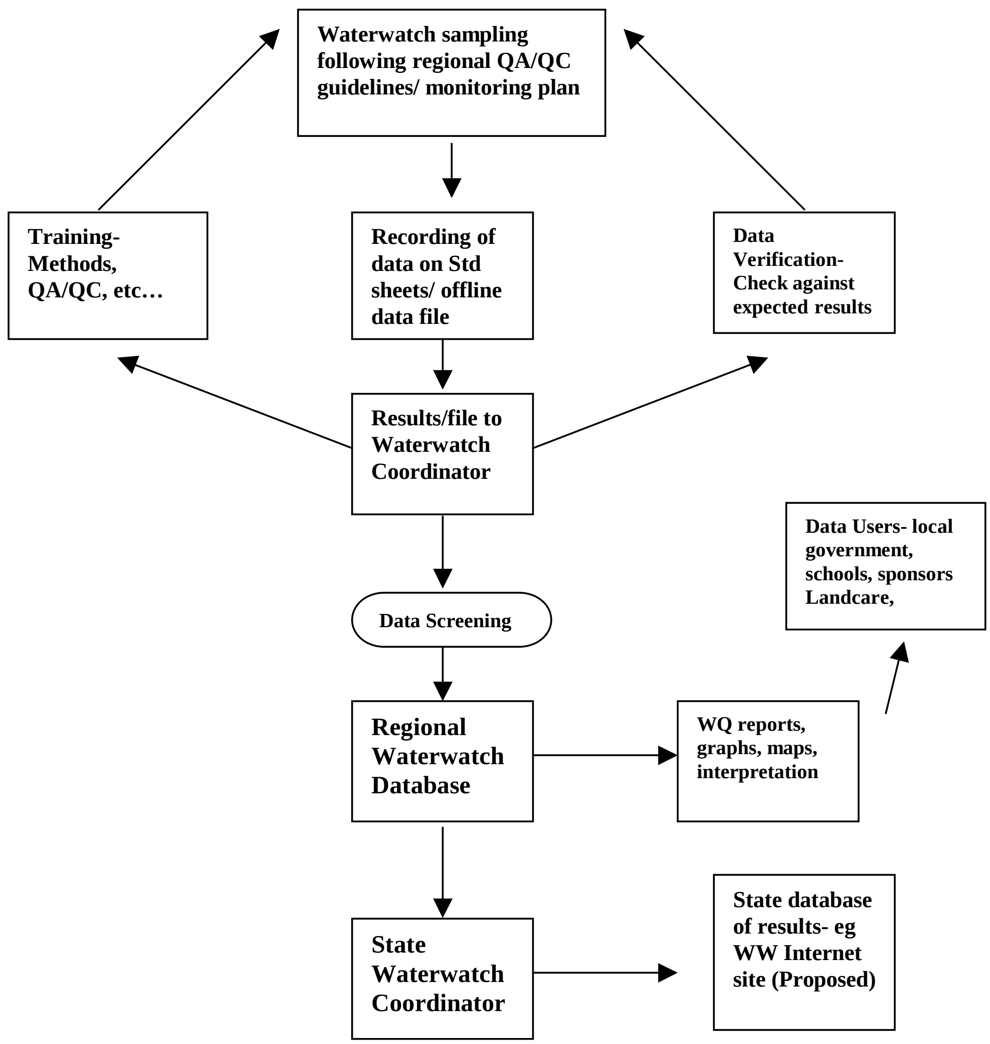

Figure 4. Data validation flow chart

FIELD DATA SHEETS

Before the data is entered onto the database, there are several actions that need to take place. Monitoring groups need to complete a registration form found on the database, and co-ordinators need to assign a six-digit/alphanumeric code for each site. All group and site information should be correctly added to the database before entering group results. Once the six-digit code has been produced, it should be recorded on any results produced by monitoring groups so that data can be readily identified.

The use of standard result sheets in the field will eliminate any confusion in monitoring results (see appendix A for an example of standard data sheet). Co-ordinators should train community monitors in the use of these sheets to ensure standard record keeping. The sheets prompt the groups for a range of information that can be used to assess the accuracy of their results and factors influencing their data.

Errors on result data sheets can occur when information is incorrectly recorded, writing is illegible or incorrect units are used. All these errors should be picked up during data screening and addressed immediately by coordinators.

WATERWATCH DATABASE

It is assumed that all data is being stored on the nationally developed Waterwatch database, which has many built-in QC checks. These include compulsory completion of specific fields, prompts for the use of specific units for each parameter and areas to store QC measures undertaken during sampling.

ANALYSIS AND INTERPRETATION OF DATA

Analysis and interpretation of data can be challenging because of the variation in monitors, equipment and sites within the monitoring programme. The purpose behind a monitoring project, will influence what needs to be reported and how much detail is required for the interpretation of the results. Interpreting the data involves organising the data to show **findings** and to develop **conclusions** and **recommendations**.

The findings are observations about your data. For example, which monitoring sites exceeded water quality guidelines and when. Whereas, *conclusions are an explanation of why your data looks the way it does and what factors may have influenced the results*. Recommendations describe what action should be taken and what further information should be gathered.

The use of statistical analysis can be used for presentation purposes and to evaluate the data. The main statistical tools used for data set analysis are briefly covered below.

- Count- *number of data points*
- Minimum - *the smallest value in the data set*
- Maximum - *the largest value in the data set*
- Mean or Average - *the sum of all the data divided by the number of data (can be influenced by extreme results)*
- Standard Deviation - *a measure of the variation or range in the data from the average.*

- Percentile - *expressed as a percentile eg. 10^{th} percentile or 90^{th} percentile. If all the data was sorted in ascending order, the 10^{th} percentile would be that value below 10% of the data lies. Percentiles give an indication of the spread of the data.*
- Median - *the middle value of the data set.*

A full discussion of data interpretation is beyond the scope of this manual, but some areas that you should consider when analysing your data include:

- The sensitivity of the methods and equipment you used. This will constrain what you are able to say. For example, concentrations of orthophosphate below 0.1 mg/l are undetectable if you used an orthophosphate kit with colour panels (eg. Merck Aquaquant). These should not be reported as 0, but as <0.10mg/l.
- The degree of change that is important for each parameter. Changes in results are relative – your ability to discuss changes in parameters over time, site or season will be affected by the baseline levels, and natural variability of the parameter. For example if the levels of conductivity in a stream are naturally higher than average streams in the catchment, ecological impact thresholds for that stream may be higher than the average streams. Also, benchmark processes, such as Index of Stream Condition rating tables, can be useful for comparing your data with the baseline conditions for indicator parameters.

REPORTING

The format for data reporting will depend on the requirements of those using the information. You should consider who will use the information and how, before deciding the best way of reporting the information. The users of the data could include the public, government agency officials and Waterwatch participants, such as schools and landcare groups, all of which may have different reporting needs.

TRAINING

QA/QC METHODS

Training is an important part of any Waterwatch project. While the group members will have been closely involved with setting the objectives and strategies of their project, through training they will become skilled in the sampling and analytical methods. After training, group members should be able to:

- produce reliable credible data
- work efficiently as a team
- understand the water quality data they produce
- develop action plans as a result of monitoring

Ideally the coordinator and group training is based on the plan/act/reflect cycle of continuous improvement. The QC procedures must be identified and documented and training developed to build up the required skills. Training cannot simply be delivered through a transfer of information. Regional Waterwatch programmes need to enrich data confidence training by:

- providing diverse training forums
- following up on training checks, refreshers
- supporting samplers in the field
- following up on errors in data sheets
- making adequate resources available
- keeping participants up to date with new information
- continually making the link between data collection and the proposed outcomes.

TRAINING CHECKLIST FOR MONITORING GROUPS AND COORDINATORS

☑ **Monitoring plan**
Worked through design of monitoring plan using the eleven basic questions. Established what aspects and level of training are required.

☑ **Sampling theory**
Although sampling techniques may have been touched on briefly when designing a monitoring plan, it is important that all practical aspects are covered in the field.

Areas to be explained include: sampling techniques, sample bottle cleaning, correct sampling procedures for different parameters eg. macro's sweep or kick, sample storage being analysed off site and sample identification/labelling for samples being laboratory tested.

☑ **Physical, chemical and biological parameters**
All methods for parameters being tested by monitoring groups to be explained. Areas include why they are being tested, what they are measuring, QA/QC, field methods, identification of macro-invertebrates, habitat surveys, factors influencing the parameter and safety aspects. *As the groups skills develop advanced and refresher training will be required.*

☑ **Use and care of field equipment**
This is often the area that is neglected and is the key area in ensuring data confidence within a group. Hands-on training for the correct use of field equipment Areas of training include: equipment calibration, limitations, servicing, troubleshooting and equipment care.

☑ **Recording of data**
Standard data sheets used and all information to be filled in correctly. Monitoring groups to be trained in how to record data, correct reporting units, incident reporting, where the data goes to and offline data entry if it is used.

☑ **Data management**
Data management is the responsibility of regional Waterwatch. Training needed by Waterwatch Co-ordinators include QA/QC techniques, Waterwatch database use and implementation of data management processes.

☑ **Data analysis and interpretation**
Discussion with the monitoring group as to how the data needs to be reported. Both the Waterwatch co-ordinator and monitoring group require skills in: appropriate graphing techniques to analyse the data, application of simple statistics to data sets and interpretation of results against known standards.

There is a wealth of training references available for background information and these should be made available to Waterwatch monitors to increase their skills and knowledge. Training records for each group should be kept and regularly updated to assess monitoring group's progression and future training needs. An example of a training log book sheet is outlined below.

It is an easy reference system to monitor group requirements and documents the professional development of Waterwatch within a monitoring group. As new monitors from a group are trained, whether it be a school group, Landcare group or a new Waterwatch coordinator, their training records are simply added to the logbook.

Waterwatch region: *Corangamite Waterwatch*			
Catchment: *Barwon*	**Coordinator:** *A. McCarthy*		
Site(s) Monitored (site codes): *BAR010 – BAR030*			
Group Name: *Forrest Primary School*			
Name:	**Training Aspect:**	**Trained by:**	**Date:**
Mr I Davis (Teacher)	*Introduction to Waterwatch / Monitoring Plan Design*	*M. Sayers*	*2/3/1999*
Grade 3	*Sampling Techniques*	*M. Sayers*	*22/3/1999*
Grade 3	*Equipment Use*	*A. McCarthy*	*22/3/1999*
Grade 3	*Macro- invertebrates*	*A. McCarthy*	*21/6/1999*

Figure 5 Example of a Data Training Log Book used for each monitoring group

RECORD KEEPING

QA/QC METHODS

Documentation is part of the quality assurance of the project. By definition, having purposeful monitoring projects implies that the data is to be used. Whether the user is the group who collected the data or some other party, it is important that the end users be able to check the accuracy of the data by referring to any step of the data collection process. To this end, accurate records of all stages of a monitoring project and all QC checks should be carefully documented.

Records ensure that data results are traceable and errors in equipment can be detected and addressed early on. The following checklist ideally shows what records should be kept for regional programmes and monitoring groups.

CHECKLIST FOR DOCUMENTATION NEEDED

All this information should be kept in a central records folder and be available on request for reference.

☑ **Monitoring plan**
Monitoring plans need to be documented with the responsibilities for each area outlined. For example, QA/QC, data management and analysis, communication, sampling and reporting.

☑ **Sampling and measuring techniques**
Equipment, sampling and method techniques (Methods Manual and Equipment Manual). QC procedures documented, for example a regional document stating QC checks.
Calibration Records for monitoring equipment. See Appendix B for pH, Appendix C for EC.
Equipment servicing procedure (appendix D) and service record form (Appendix E).

☑ **Data management and validation**
Field data recording sheets. Data flow chart documented (see figure 4)

☑ **Training**
Monitoring group and Co-ordinator training logbook (see figure 5).

APPENDIX A - PHYSICAL & CHEMICAL TEST RECORD SHEET

Physical & Chemical Tests Record Sheet

Complete the Physical & Chemical Tests Record Sheet Monthly

Site Name:			Site Code:
Name of Monitoring Group:			
Person(s) Conducting the Survey / Test			
Date of Survey or Test:	Site grid reference	Easting (4 digit no.)	
Time of Survey or Test:		Northing (5 digit no.)	

Test	**What it measures**	**Your result (units)**	**Comments**
D.O.	Oxygen concentration	% sat.	
pH	Acidity / Alkalinity		
Air Temperature	Temperature	° C	
Water Temperature	Temperature	° C	
Conductivity	Salinity	E.C.	
Turbidity	Suspended solids	N.T.U.	
Soluble Phosphorus as P	Nutrient levels	mg/L	
Stream flow	Flow rate	litres / sec	

Location of drains: Record the type and location of any drains near your monitoring site.

Distance from drain to monitoring site: ________________ Metres ☐ Upstream ☐ or downstream

Type ☐ Open drain ☐ Pipe ☐ Drain flow ☐ Drain not flowing

Drain size ☐ Open drain width ____________________ ☐ Pipe diameter ____________________

Description of drain water Colour Odour

Weather conditions at the time of sampling:

☐ sunny ☐ cloudy ☐ overcast ☐ raining ☐ windy

Rainfall:

Last rainfall ☐ More than week ago ☐ During the last week ☐ During the last 24 hours ☐ Raining now

Amount of rain

Water conditions:

Water flow

☐ Not flowing ☐ Slow

☐ Fast ☐ Rapid

☐ Temporary ☐ permanent

Water appearance:

☐ Clear ☐ Milky ☐ Foamy /frothy

☐ Muddy ☐ Smelly ☐ Stained green

☐ Scummy ☐ Oily ☐ Strained brown

☐ Other (description)

Deepest part of stream: (estimate only) ☐ Up to 50 cm ☐ Up to I metre ☐ Up to 2 metres

☐ Up to 5 metres ☐ Over 5 metres ☐ unknown Average width of stream: cm)

Litter pollutants: (Tick type found) ☐ Plastic ☐ Clothing ☐ Car bodies

☐ paper ☐ bottles ☐ Polystyrene ☐ Oil ☐ Petrol/diesel

☐ packets ☐ cans ☐ Waxed cardboard ☐ other

APPENDIX B - WATERWATCH CALIBRATION RECORD

pH Calibration Record Sheet

pH Meter No:	**Make and Model:**
Supplier:	**Date Purchased:**
Waterwatch region:	**Catchment:**
Group Name:	**Coordinator:**

* Record reading before adjusting calibration i.e. before pressing “con” button.

pH Meter Type:

Date	**Calibration 1 7.00***	**Calibration 2 4.00 or 10.00**	**Analyst**	**Comments: Serviced etc.**

APPENDIX C - WATERWATCH CALIBRATION RECORD

Electrical Conductivity

Instrument Number:	Make and Model:
Date Purchased:	
Supplier:	
N.B Record reading before adjusting calibration	
Waterwatch region:	
Catchment:	**Coordinator:**
EC Meter Type:	**EC Meter No:**
Group Name:	

Date	**Standard value(µS/cm)**	**Meter Result (µS/cm*)**	**Analyst**	**Comments: Serviced etc.**

* µS/cm: micro siemens per centimeter, standard units for reporting EC results.

APPENDIX D - WATER MONITORING KIT SERVICING

SERVICING YOUR WATER MONITORING KIT

The water quality kits used by both primary schools and landcare groups need to be regularly serviced, approximately every 4 months. This ensures probes, glassware, etc., are clean and results obtained are accurate. This two-page guide will help you follow an easy procedure to cleaning all the equipment used.

What the servicing kit should contain :

- 1 litre bottle fresh conductivity standard to suit testing range.
- 1 drop bottle of 50% methylated spirits.
- Fresh pH 7 buffer.
- 2 waste bottles.
- 2 bottles of distilled water.
- Two small beakers.
- Fresh pH 10 buffer.
- Safety gloves and glasses.
- 1 box of tissues.
- Replacement batteries/pH buffers.
- 1 litre bottle 10% HCL.

WARNING :

Wear safety gloves and glasses when handling any acids or chemicals.

All wastes should be disposed of into the wastes bottle and returned to the lab.

pH METER

The glass probe on the pH meter is very sensitive and needs to be thoroughly cleaned with acid and methylated spirits to remove any contaminants affecting the performance of this meter.

- Place the probe in a beaker with enough 0.1M Hydrochloric acid (HCL) to cover the probe only, allow probe to soak in the acid for no longer than 1 minute. Rinse the probe thoroughly with tap water and wipe dry with a tissue.
- Place a few drops of methylated spirits on a tissue and gently wipe the glass probe clean, be careful not to touch the probe. Rinse the probe with distilled water and place probe in a fresh pH 7 and pH 10 buffer to check calibration.

** N.B. Replace the pH 7 and pH 10 buffers with the new buffers supplied in the servicing kit. Check that batteries are OK. Often the meter won't calibrate if batteries are on the way out. Check levels of Buffers and distilled water. Replenish if low. Remember to leave the pH meter soaking in the pH buffer 7 when not in use (mention this to groups).*

PHOSPHATE KIT

Contamination of the glass tubes within the phosphate kit may occur at any time. It is important that these glass tubes are soaked in acid to remove any phosphate that is bound to the glass.

- Fill both glass tubes to the top with 10% HCl. Cap and invert several times. Allow tubes to stand for approximately 15-20 minutes.
- After elapsed time pour into waste bottle and rinse both tube and cap thoroughly with distilled water, wipe outside of glass with a few drops of methylated spirits on a tissue.
- Check chemical levels are sufficient, in date and appearance is normal. If need replacing, report to Coordinator.

CONDUCTIVITY METER

The stainless steel electrodes need to be kept clean and free from dirt etc., to ensure accurate readings are obtained.

- To a beaker add enough 50% methylated spirits to cover the electrodes only. Allow to stand for 15-20 minutes.
- After elapsed time, pour into waste bottle and gently wipe the electrodes with a tissue then rinse with distilled water.

**** N.B.*** *Replace the conductivity standard and check to see if the meter is correctly calibrated. If reading is out, adjust by using the screwdriver and the small screw in the back of the meter. Check batteries as well particularly if reading is faint, won't stabilize, disappears or won't calibrate.*

D.O. KIT

The glassware used in D.O. determination also needs to be clean and free of contaminants.

- Fill the sample bottle and 20mL container with 10% HCl and leave to soak for 10-15 minutes.
- Then rinse thoroughly with tap and distilled water.
- Fill the syringe titrator with 10% HCl and leave to soak for 5 minutes.
- Rinse with tap, then distilled water. Wipe the outside of the glass clean with a few drops of methylated spirits on a tissue

**** N.B.*** *Check chemical levels are within date, and sufficient to do the test. If getting low, report to Co-ordinator.*

TURBIDITY TUBE, THERMOMETER

These two items are easily cleaned. The thermometer should be checked for any cracks and glass should be clean to make readings easy. The turbidity tube should also be free from dirt both inside and out. Rinsing with tap water should remove all dirt from inside and wiping the outside of tube should clean the plastic.

**** N.B.*** *Fill out a service form for each kit serviced reporting any problems or questions groups have. If batteries are replaced please mark this down and hand forms back to Co-ordinator.*

APPENDIX E WATER MONITORING SERVICE FORM

WATER MONITORING SERVICE FORM

WATERWATCH Victoria
Communities Caring for Catchments

Name of Monitoring Group:	Equipment/ Kit Number:
Contact Person:	Date:

EQUIPMENT SERVICE

pH Meter Equipment No.: ....

❒ Cleaned ❒ Calibrated ❒ Batteries Replaced

❒ pH Buffer Levels (Replenish if less than 3 tablets left : Maximum of 10 needed)

Conductivity Meter Equipment No.: ....

❒ Cleaned ❒ Calibrated ❒ Batteries Replaced

❒ Standard Replaced

Phosphorus Kit Equipment No.: ....

❒ Glassware Cleaned ❒ Chemical Levels OK (If not report below)

D.O. Kit Equipment No.: ....

❒ Glassware cleaned ❒ Chemical Levels OK (If not report below)

Turbidity Tube Equipment No. .... ❒ Cleaned

Thermometer Equipment No. .... ❒ Cleaned

Equipment Problems:

....

....

....

Serviced by : ....

APPENDIX F – EXAMPLE MONITORING PLAN

Springfield Landcare Group

Springfield Wetlands

Waterwatch Monitoring Plan

Monitoring Purposes

- To ensure the viability of the site, for which we are responsible through a Management Agreement with the Springfield Shire.
- To understand the ecology of the site and provide water quality information.

Information Users

- Members of Springfield Landcare group
- Students, General public for whom we conduct tours & activities
- DNRE, EPA, Springfield Shire

Information Uses

- To preserve the site as a wetland & wildlife habitat
- To maintain the site properly for its flora and fauna values
- To educate our members, students and the wider public about the site.

Parameters Monitored

- Macroinvertebrates- 4 per year
- Habitat Survey- 1 per year
- Physical and Chemical parameters- pH, EC, Turb, D.O, Temp, Ortho P- monthly

Monitoring Sites

- SPR010 Springfield Wetlands @ South Wetland
- SPR020 Springfield Wetlands @ North Wetland

Monitoring Times

- Monthly- last week of each month

Group Involvement

- Springfield Landcare members- Barney, Marge, Moe, Willy, Principal Skinner

Data Management and Presentation

- Forward to Springfield Waterwatch
- Waterwatch Database
- End of year graph of individual parameters

Data Credibility

- Regular calibration of meters
- Participate in region QA/QC program
- Attend local Waterwatch training sessions.
- Data credible enough to be used in report for shire.

Facilatator. Homer J Simpson (Springfield Region Waterwatch Program) ph: 555 98555