

Streamwatch Curriculum Support



Helping high school teachers
implement Streamwatch into their programs

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Introduction

Streamwatch is a dynamic environmental action network, educating and empowering communities to work together for healthy catchments. Primary schools, high schools and community groups participate in the Streamwatch program.

The Streamwatch program in high schools comprises field based water quality monitoring using the Streamwatch 'Black kit'. The black kit enables groups to test for parameters such as temperature, pH, electrical conductivity, turbidity, phosphorous, dissolved oxygen and faecal coliform. The standard methodology for these water quality tests, safety instructions and information on Australian water quality guidelines are located in the Streamwatch Manual.

The Streamwatch program, together with the manual provides excellent resources for teachers seeking an applied approach, to enable their students to achieve syllabus outcomes. This is especially true for those involved in agricultural, geographical, mathematical, scientific or environmental studies with students.

The Streamwatch program provides a structured way for groups of students to be actively involved in a project in their local catchment, by monitoring their local creeks, rivers, lakes, dams and estuaries. The data they collect and load onto the Streamwatch website (www.streamwatch.org.au) is used by stakeholders, such as local government, to assist them in their decision making.

This curriculum support document shows how the Streamwatch program can be used to meet outcomes from the NSW Board of Studies high school syllabuses in TAS, HSIE, Mathematics and Science Key Learning Areas. By participating in the Streamwatch program students can work toward achieving syllabus outcomes in Agriculture, Geography, Mathematics, Science, Chemistry, Physics, Biology and Earth and Environmental Science. It also suggests how the Streamwatch program can be used to meet the objectives of the NSW Environmental Education Policy.

To view a copy of the Streamwatch Manual, visit www.streamwatch.org.au

1 Agriculture

1.1 Introduction

Practical investigations that involve students collecting, analysing and organising information as well as communicating ideas and information, are a significant part of the study of Agriculture. The Streamwatch program can provide opportunities for students to participate in these aspects of the learning process.

Agriculture as a practical subject is influenced by external factors including water bodies. These include creeks, rivers, lakes, dams and estuaries. The ecology and health of these aquatic systems can in turn be greatly affected by farm management practices such as the appropriate use of pesticides, fertilisers and the management of farm animals that may damage stream banks or produce effluent that can be a pollutant.

Participation in the Streamwatch program provides students with opportunities to learn first-hand about the importance of healthy waterways and encourages learning about the management of agriculture production systems in such a way as to contribute to ensuring a sustainable future.

1.2 Stage 4 and 5 Agriculture outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Stage 4 and 5 Agriculture outcomes. A student:

- 4.5.1 *performs controlled experiments in agricultural contexts*
- 4.5.2 *communicates experimental data using a range of information and communication technologies*
- 4.6.1 *follows safety and hygiene instructions when using chemicals, tools and agricultural machinery in accordance with Occupational Health and Safety requirements*
- 5.5.1 *designs, undertakes, analyses and evaluates experiments and investigates problems in agricultural contexts*
- 5.5.2 *collects and analyses agricultural data and communicates results using a range of technologies*
- 5.6.1 *applies Occupational Health and Safety requirements when using, maintaining and storing chemicals, tools and agricultural machinery.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 4 and 5 Agriculture Technology outcomes.

Streamwatch Manual section	Stage 4/5 Agriculture Technology syllabus outcomes					
	4.5.1	4.5.2	4.6.1	5.5.1	5.5.2	5.6.1
Welcome	X	X	X	X	X	X
Temperature	X	X	X	X	X	X
pH	X	X	X	X	X	X
Electrical conductivity	X	X	X	X	X	X
Turbidity	X	X	X	X	X	X
Dissolved oxygen	X	X	X	X	X	X
Available phosphate			X			X
Faecal coliforms			X			X
Aquatic macroinvertebrates			X			X
Water quality guidelines				X	X	

Table 1: Streamwatch applications to Stage 4 and 5 Agriculture Technology syllabus outcomes.

1.3 Stage 5 Agriculture activity

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes.

- 5.5.1 *designs, undertakes, analyses and evaluates experiments and investigates problems in agricultural contexts*
- 5.5.2 *collects and analyses agricultural data and communicates results using a range of technologies*
- 5.6.1 *applies Occupational Health and Safety requirements when using, maintaining and storing chemicals, tools and agricultural machinery.*

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Context

Fish farming is a commercial enterprise that is gaining popularity in Australia and has huge potential for further growth.

A number of fish species are being commercially grown in rivers and farm dams. These include Murray cod, trout and silver perch.

Commercial production of fish requires management of diseases, parasites, water quality and diet. In this exercise you will be focusing on reviewing requirements of water quality.

Each fish species has specific environmental requirements related to water quality. Each species of fish has optimum requirements for water temperature, pH, salinity and dissolved oxygen levels. Some of these are listed in the table below:

	Temperature (°C)	pH (pH units)	Salinity	Dissolved oxygen (mg/L)
Murray cod	24–25	6–8	low	>3
Trout	10–18	6.4–8.4	low to sea water levels	>5–5.5
Silver perch	23–28	<10.2	low	>2.2

Description of activity

Use the instructions in the Streamwatch Manual to help you measure the temperature, pH, electrical conductivity and dissolved oxygen levels of a sample of water from a local river, stream or creek. Ensure that you take particular notice of all safety directions outlined in the manual when performing these measurements.

- Gather all equipment required.
- Conduct tests as per the instructions in the Streamwatch Manual.
- Record your results in a table with the following headings: temperature, pH, electrical conductivity, dissolved oxygen.

Analyse your results then use the information in the table above and your investigation results to answer the following questions.

- a) Which fish species, Murray cod, trout or silver perch, would be best suited to the water temperature you measured? What do you predict might happen to the growth of this fish when water temperature decreases?
- b) Murray cod prefer to live in deep holes in the river bottom often produced by fallen trees. Describe how you could modify the Streamwatch Manual recommended method for measuring water temperature to investigate whether the water was suitable for Murray cod.
- c) Is the pH level of the water you tested suitable for all the fish species listed in the table above? If the pH of the water rose because of a pollutant, which fish species would most likely to be affected first?
- d) Is the salinity level of the water you tested suitable for all or any of the fish species listed in the table above? Do you notice variations in the salinity over time or on different days? Can you suggest a cause for salinity variations in streams?

- e) Is the dissolved oxygen level of the water you tested suitable for all or any of the fish species listed in the table above? Which of the fish species could thrive in the conditions you found in your water testing for dissolved oxygen?
- f) Dissolved oxygen levels in the water fall when the temperature increases. This means that dissolved oxygen levels are lowered. Explain how high water temperatures might affect fish production.
- g) Which fish species do you predict would be most suited to farming in the water you tested? Justify your answer.

Criteria for assessment

Students submit their report and are assessed on their ability to:

- describe the water quality in the catchment
- identify the factors that might cause changes in the water quality in the catchment and explain the impacts of any changes on the sustainability of the catchment for farming specified fish species
- communicate their research methods and justify their findings and conclusions.

1.4 Stage 6 Agriculture outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Stage 6 Agriculture outcomes. A student:

Preliminary Agriculture outcomes

P2.1 *describes the biological and physical resources and applies the processes that cause changes in plant production systems.*

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HSC Agriculture outcomes

H1.1 *explains the influence of the physical, biological, social, historical and economic factors on sustainable agricultural production*

H4.1 *applies appropriate experimental techniques, technologies, research methods and data presentation and analysis in relation to agricultural problems and situations.*

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Preliminary course students could include water testing data when compiling a report outlining the physical resources of a farm for their case study. This activity would also contribute to skill development in data collection using appropriate instruments. In Year 12, students could look at the effects on water quality by land management practices.

The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 Agriculture outcomes.

Stage 6 Agriculture syllabus outcomes			
Streamwatch Manual section	P2.1	H1.1	H4.1
Welcome			
Temperature	X	X	X
pH	X	X	X
Electrical conductivity	X	X	X
Turbidity	X	X	X
Dissolved oxygen	X	X	X
Available phosphate	X	X	X
Faecal coliforms	X	X	X
Aquatic macro-invertebrates		X	X
Water quality guidelines	X		

Table 2: Streamwatch applications to Stage 6 Agriculture syllabus outcomes.

1.5 Stage 6 Agriculture activity

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes.

H1.1 *explains the influence of the physical, biological, social, historical and economic factors on sustainable agricultural production.*

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Context

Many animals spend most (or all) of their lives in or near water. These animals include fish, frogs, water birds, freshwater snails, leeches, freshwater crayfish and dragonfly larvae. Each of these animals has specific water quality requirements.

Measures of temperature, pH, turbidity, dissolved oxygen, electrical conductivity, nutrients, faecal coliforms and aquatic macroinvertebrate populations are indicators of water quality. A change in water quality will affect the aquatic ecosystem causing populations to fluctuate.

Water quality is affected by many natural and human activities. For example, the surrounding rock types and soils will influence water pH, and leaching of fertilisers affects nutrient levels.

In this exercise you will explore the effects of agricultural activities on water quality.

Description of activity

Use the Streamwatch Manual to help you perform the required tests to determine the water quality of a local creek, river, lake, dam or estuary. Ensure that you take particular notice of all safety directions as outlined in the manual when using chemicals and performing any tests. Do a risk assessment before commencing your testing.

- **Measure and record the temperature of the water.**

Most aquatic organisms are cold blooded, which means they are unable to internally regulate their core body temperature. All species of aquatic organisms have preferred temperature ranges. As the temperature gets too far above or below the preferred range, the number of species and the number of individuals of a species decreases until finally there are few or none.

- **Measure and record the pH of the water.**

Leaching from acid sulfate soils can reduce the pH of the waterway. Describe what might happen to aquatic life if pH levels are reduced below 6.5. How might a farmer prevent run-off from acid sulfate soils affecting waterways?

- **Measure and record the electrical conductivity of the water.**

This will indicate the salinity level of the waterway. High salt concentrations can adversely affect fish and aquatic invertebrate populations. An increase in salinity can also reduce dissolved oxygen levels. Some agricultural activities increase salinity levels in waterways. List two farm management practices that reduce the likelihood of increased salinity levels.

- **Measure and record the turbidity of the waterway.**

Turbidity is a measure of the clarity of water. High turbidity can reduce levels of aquatic plant and animal life. One of the main causes of high turbidity is eroded soil washed into waterways as run off. Describe a farm management practice that reduces run off of soil into waterways.

- **Measure and record the available phosphate of your water sample.**

Phosphorus, present in phosphate, is an essential nutrient for both plants and animals. However, in high concentrations in water, phosphates can have severe consequences such as encouraging excessive plant growth resulting in the choking of waterways, reduced light penetration and lowered oxygen levels due to an abundance of plants. In extreme cases this can lead to fish kills. Phosphate levels in waterways may be increased due to the use of phosphate fertilisers on crops and pastures and manure from feedlots. Describe one management practice that will prevent phosphate from agriculture entering waterways.

Manure from livestock can increase faecal coliforms in water, which can affect the health of humans and the environment. Outline one way manure can enter waterways and explain how this can be prevented.

Criteria for assessment

Students submit their report and are assessed on their ability to:

- describe the water quality in the catchment
- identify the factors that might cause changes in the water quality in the catchment and explain the impacts of any changes on the suitability of the catchment for farming practices
- identify farming practices that form the basis of best practice in sustainable farming enterprises and catchment preservation
- communicate their research methods and justify their findings and conclusions.

2 Geography

2.1 Introduction

The Streamwatch program deals with real-life situations, encouraging students to find solutions to the problems facing waterways. As such it provides an excellent resource for teachers to assist their classes to meet not only the aims of the Geography syllabuses but specific outcomes as well.

Streamwatch is particularly applicable to HSC Geography through the use of fieldwork to investigate particular local ecosystems within the *Ecosystems at Risk* topic.

Streamwatch develops students' knowledge, understanding, skills, values and attitudes of geographical phenomena (catchments) and prepares students for informed and active citizenship in a changing world (Stage 4-5 Geography syllabus). It involves both fieldwork and investigating contemporary geographical issues, two other important features of the junior syllabus.

2.2 Stages 4 and 5 Geography outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Stage 4 and 5 Geography outcomes. A student:

- 4.1 *identifies and gathers geographical information*
- 4.2 *organises and interprets geographical information*
- 4.10 *explains how geographical knowledge, understanding and skills combine with knowledge of civics to contribute to informed citizenship*
- 5.1 *identifies, gathers and evaluates geographical information*
- 5.2 *analyses, organises and synthesises geographical information*
- 5.10 *applies geographical knowledge, understanding and skills with knowledge of civics to demonstrate informed and active citizenship.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 4 and 5 Geography outcomes.

Streamwatch Manual section	Stage 4/5 Geography syllabus outcomes					
	4.1	4.2	4.10	5.1	5.2	5.10
Welcome			X			
Temperature	X	X	X	X	X	X
pH	X	X	X	X	X	X
Electrical conductivity	X	X	X	X	X	X
Turbidity	X	X	X	X	X	X
Dissolved oxygen	X	X	X	X	X	X
Available phosphate	X	X	X	X	X	X
Faecal coliforms	X	X	X	X	X	X
Aquatic macroinvertebrates	X	X	X	X	X	X
Water quality guidelines			X			X

Table 3: Streamwatch applications to Stage 4 and 5 Geography syllabus outcomes.

2.3 Stage 5 Geography activity

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes.

- 5.1 *identifies, gathers and evaluates geographical information*
- 5.2 *analyses, organises and synthesises geographical information*
- 5.3 *selects and uses appropriate written, oral and graphic forms to communicate geographical information*
- 5.5 *explains the geographical processes that form and transform Australian environments.*

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Context

This research activity occurs towards the end of a unit on **Issues in Australian Environments (5A3)**. This activity builds on the knowledge and analytical skills introduced earlier in the unit, where students have researched the nature of their local catchment. Students investigate spatial and ecological dimensions of water management in the catchment with the aid of the Streamwatch program.

Description of activity

Students are to investigate the changes in the water quality along the length of a stream in a local catchment. In groups, the students acquire and process water quality data from their part of the catchment as members of the Streamwatch program.

Students then:

1. Write a group fieldwork report with sketch maps, diagrams and photographs to show processes and spatial dimensions of the study area.
2. Compare their findings with those of other Streamwatch groups along the length of the stream with the aid of the Streamwatch website (www.streamwatch.org.au).
3. Outline the factors that account for the differences in water quality in the catchment through class discussion and brainstorming.
4. Add a description of the factors influencing water quality in the catchment to their report.

Criteria for assessment

Students submit their report and are assessed on their ability to:

- locate and describe the character of the catchment
- describe the changes in water quality in the catchment
- identify the factors causing changes in the water quality in the catchment and explain the impacts of this change
- integrate stimulus material and communicate their research using media such as maps, tables and graphs etc.

2.4 Stage 6 Geography outcomes

Streamwatch provides a framework and a context for the type of environmental inquiry that is central to Stage 6 Geography. One of the aims of the Stage 6 course is to enable students to study the spatial and ecological dimensions of biophysical and human phenomena in a changing world. Geographical inquiry is fundamental to all topics in the Preliminary and HSC courses.

Preliminary Geography outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Preliminary Geography outcomes. A student:

- P.7 *formulates a plan for active geographical inquiry*
- P.8 *selects, organises and analyses relevant geographical information from a variety of sources*
- P.9 *uses maps, graphs and statistics, photographs and fieldwork to conduct geographical inquiries*
- P.10 *applies mathematical ideas and techniques to analyse geographical data*
- P.11 *applies geographical understanding and methods ethically and effectively to a research project*
- P.12 *communicates geographical information, ideas and issues using appropriate written and/or oral, cartographical and graphic forms.*

The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 Preliminary Geography outcomes.

Streamwatch Manual section	Stage 6 Preliminary Geography syllabus outcomes					
	P.7	P.8	P.9	P.10	P.11	P.12
Welcome	X					X
Temperature	X	X	X	X	X	X
pH	X	X	X	X	X	X
Electrical conductivity	X	X	X	X	X	X
Turbidity	X	X	X	X	X	X
Dissolved oxygen	X	X	X	X	X	X
Available phosphate	X	X	X	X	X	X
Faecal coliforms	X	X	X	X	X	X
Aquatic macroinvertebrates	X	X	X	X	X	X
Water quality guidelines				X		

Table 4: Streamwatch applications to Stage 6 Preliminary Geography syllabus outcomes.

HSC Geography outcomes

Fieldwork is an important and significant part of the HSC Geography course. Fieldwork is integrated with the teaching and learning program to take advantage of the enhanced understanding achieved through direct observation, field measurements and inquiry learning.

Students working in the field with the Streamwatch Manual are working towards achieving some of the Geography outcomes most effectively accomplished by fieldwork.

The Streamwatch program provides opportunities for students to work toward achieving the following HSC Geography outcomes. A student:

- H.7 *justifies geographical methods applicable and useful in the workplace and relevant to a changing world*
- H.8 *plans geographical inquiries to analyse and synthesise information from a variety of sources*
- H.9 *evaluates geographical information and sources for usefulness, validity and reliability*
- H.10 *applies maps, graphs and statistics, photographs and fieldwork to analyse and integrate data in geographical contexts*
- H.11 *applies mathematical ideas and techniques to analyse geographical data*
- H.12 *explains geographical patterns, processes and future trends through appropriate case studies and illustrative examples*
- H.13 *communicates complex geographical information, ideas and issues effectively, using appropriate written and/or oral, cartographic and graphic forms.*

The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 HSC Geography outcomes.

Streamwatch Manual section	Stage 6 HSC Geography syllabus outcomes						
	H.7	H.8	H.9	H.10	H.11	H.12	H.13
Welcome		X	X		X	X	
Temperature	X	X	X	X	X		X
pH	X	X	X	X	X		X
Electrical conductivity	X	X	X	X	X		X
Turbidity	X	X	X	X	X		X
Dissolved oxygen	X	X	X	X	X		X
Available phosphate	X	X	X	X	X		X
Faecal coliforms	X	X	X	X	X		X
Aquatic macroinvertebrates	X	X	X	X	X		X
Water quality guidelines		X				X	X

Table 5: Streamwatch applications to Stage 6 HSC Geography syllabus outcomes.

2.5 Stage 6 Geography activity

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes.

- P.2 *describes the interactions between the four components that define the biophysical environment*
- P.3 *explains how a specific environment functions in terms of biophysical factors*
- P.7 *formulates a plan for active geographical inquiry*
- P.8 *selects, organises and analyses relevant geographical information from a variety of sources*
- P.9 *uses maps, graphs and statistics, photographs and fieldwork to conduct geographical inquiries*
- P.12 *communicates geographical information, ideas and issues using appropriate written and/or oral, cartographical and graphic forms.*

© Board of Studies 1999 Geography syllabus

Context

The Senior Geography Project (SGP) is a research activity that can be programmed in a number of different ways in the Preliminary course. In this activity the SGP builds on the knowledge and analytical skills introduced earlier in a unit on the *Biophysical Interactions*. In this unit students have researched the nature of the interactions between, and the human impacts on, the functioning of the biosphere, lithosphere and hydrosphere. Students investigate the issue of urban run-off in a local catchment with the aid of the Streamwatch program.

Description of activity

Students are to investigate the issue of urban run-off in a local catchment with the aid of the Streamwatch program. This investigation is to be completed using no more than one period of class time per week for eight weeks. The steps to be followed in fieldwork research are as follows.

1. Frame a geographical question or problem concerning the impact of urban run-off on the local catchment.
2. Devise a method of inquiry.
3. Design an appropriate research approach and keep a log of research activities.
4. Collect and record data with the aid of the Streamwatch black kit.
5. Process and analyse the information.
6. Draw conclusions that address the original question or problem.

Students should then present their findings as either:

- a geographical report of up to 2000 words incorporating maps, diagrams, tables, graphs and photographs
- an audio-visual display
- a pictorial essay.

Criteria for assessment

Students submit their research plan, a log of their research and present a report. Students are assessed on their ability to:

- formulate a plan of active geographical inquiry
- explain the impact of urban run-off on the local catchment, biosphere and lithosphere
- conduct geographical inquiry using maps, graphs and statistics, photographs and fieldwork
- communicate their research results.

3 Mathematics

3.1 Introduction

The Streamwatch program is ideal for allowing students an opportunity to develop an understanding of the importance of mathematics as a tool, especially in Stage 4 and 5, in the scientific investigation, and preservation of natural resources.

While most of the Streamwatch program is designed around a scientific framework it draws heavily on aspects of the whole curriculum and is an ideal cross curriculum project.

In the Stage 6 Mathematics curriculum the Streamwatch program has applications in the General Mathematics course. The main areas where it provides opportunities for students to work toward achieving outcomes are in Data Analysis and Measurement.

3.2 Stage 4 and 5 Mathematics outcomes

In the Year 7-10 Mathematics syllabus emphasis is placed on the ability of students to work mathematically. The Streamwatch program assists students in working mathematically through the collection and analysis of real-life applied data.

Students need to develop the ability to:

- question
- apply appropriate strategies in investigations
- communicate the results of the investigation using mathematical terms
- reason
- give suitable explanations for the findings
- reflect upon both the process and the impact of the results of the investigation on society and the environment.

The Streamwatch program provides opportunities for students to work toward achieving the following Stage 4 and 5 Mathematic outcomes. A student:

WMS4.1 *asks questions that could be explored using mathematics in relation to Stage 4 content*

WMS4.2 *analyses a mathematical or real-life situation, solving problems using technology where appropriate*

WMS4.3 *uses mathematical terminology and notation, algebraic symbols, diagrams, text and tables to communicate mathematical ideas*

WMS4.4 *identifies relationships and the strengths and weaknesses of different strategies and solutions, giving reasons*

WMS4.5 *links mathematical ideas and makes connections with, and generalisations about, existing knowledge and understanding in relation to Stage 4 content*

WMS5.1.1 *asks questions that could be explored using mathematics in relation to Stage 5.1 content*

- WMS5.1.2 *analyses a mathematical or real-life situation, systematically applying problem-solving strategies*
- WMS5.1.3 *uses mathematical terminology and notation, algebraic symbols, diagrams, text and tables to explain mathematical ideas*
- WMS5.1.4 *explains and verifies mathematical relationships*
- WMS5.1.5 *links mathematical ideas and makes connections with, and generalisations about, existing knowledge and understanding in relation to Stage 5.1 content*
- NS4.1 *recognises the properties of special groups of whole numbers and applies a range of strategies to aid computation*
- NS4.2 *compares, orders and calculates with integers*
- NS4.3 *operates with fractions, decimals, percentages, ratios and rates*
- NS5.2.1 *rounds decimals to a specified number of significant figures, expresses recurring decimals in fraction form and converts rates from one set of units to another*
- DS4.1 *constructs, reads and interprets graphs, tables, charts and statistical information*
- DS4.2 *collects statistical data using either a census or a sample, and analyses data using measures of location and range*
- MS4.3 *performs calculations of time that involve mixed units.*

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The following tables show the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 4 and 5 Mathematics outcomes.

Stage 4 Mathematics syllabus outcomes					
Streamwatch Manual section	WMS4.1	WMS4.2	WMS4.3	WMS4.4	WMS4.5
Welcome	X	X	X		
Temperature	X	X	X	X	X
pH	X	X	X	X	X
Electrical conductivity	X	X	X	X	X
Turbidity	X	X	X	X	X
Dissolved oxygen	X	X	X	X	X
Available phosphate	X	X	X	X	X
Faecal coliforms	X	X	X	X	X
Aquatic macroinvertebrates	X	X	X	X	X
Water quality guidelines	X	X	X	X	X

Table 6a: Streamwatch applications to 7-10 Mathematics syllabus outcomes – Working Mathematically.

Stage 5 Mathematics syllabus outcomes				
Streamwatch Manual section	WMS5.1.1	WMS5.1.2	WMS5.1.3	WMS5.1.4
Welcome	X	X	X	X
Temperature	X	X	X	X
pH	X	X	X	X
Electrical conductivity	X	X	X	X
Turbidity	X	X	X	X
Dissolved oxygen	X	X	X	X
Available phosphate	X	X	X	X
Faecal coliforms	X	X	X	X
Aquatic macroinvertebrates	X	X	X	X
Water quality guidelines		X		

Table 6b: Streamwatch applications to 7-10 Mathematics syllabus outcomes – Working Mathematically.

Stage 4/5 Mathematics syllabus outcomes							
Streamwatch Manual section	NS4.1	NS4.2	NS4.3	NS5.2.1	DS4.1	DS4.2	MS4.3
Welcome							
Temperature	X	X	X	X	X	X	X
pH		X		X			X
Electrical conductivity	X	X	X	X			
Turbidity	X	X					
Dissolved oxygen	X	X	X		X	X	X
Available phosphate	X	X	X		X	X	
Faecal coliforms	X	X	X	X	X	X	X
Aquatic macroinvertebrates		X	X				
Water quality guidelines							

Table 7: Streamwatch applications to other Stage 4 and 5 Mathematics syllabus outcomes.

3.3 Stage 4 and 5 Mathematics activity

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes.

- WMS4.2 *analyses a mathematical or real-life situation, solving problems using technology where appropriate*
- DS4.1 *constructs, reads and interprets graphs, tables, charts and statistical information*
- DS4.2 *collects statistical data using either a census or a sample and analyses data using measures of location and range*
- WMS5.1.1 *asks questions that could be explored using mathematics in relation to Stage 5.1 content*
- WMS5.1.2 *analyses a mathematical or real-life situation, systematically applying problem-solving strategies.*

Description of activity

Record the information gathered during your investigation and monitoring of your local stream as part of the Streamwatch program in an Excel® spreadsheet or use existing data from the Streamwatch website. Using the graphing tools available choose a suitable graph to represent each of the statistics recorded over the period of the investigation.

Report on your findings, making special mention of any fluctuations in the results should they occur. You should use the collected data as the basis for suggesting possible reasons for deviation from baseline conditions.

Criteria for assessment

Students submit their report and are assessed on their ability to:

- describe the water quality in the catchment through tabulated data and appropriate graphical representation
- identify the factors that might cause changes in the water quality in the catchment and use statistical analysis to identify anomalies in collected data
- communicate their research methods and justify their findings and conclusions.

3.4 Stage 6 Mathematic outcomes

General Mathematics outcomes

In this course, one of the focus areas of study involves students in the analysis, collection and sampling of data. They pose questions, collect data, organise data, summarise, display and analyse data before drawing conclusions, then writing a report. The Streamwatch program provides a practical and useful opportunity for students to work with data and measurement.

The Streamwatch program provides opportunities for students to work toward achieving the following General Mathematic outcomes. A student:

- P1 *develops a positive attitude to mathematics and appreciates its capacity to provide enjoyment and recreation*
- P2 *applies mathematical knowledge and skills to solving problems within familiar contexts*
- P4 *represents information in symbolic, graphical and tabular forms*
- P7 *determines the degree of accuracy of measurements and calculations*
- P9 *determines an appropriate form of organisation and representation of collected data*
- P11 *justifies his/her response to a given problem using appropriate mathematical terminology*
- H1 *appreciates the importance of mathematics in his/her own life and its usefulness in contributing to society*
- H2 *integrates mathematical knowledge and skills from different content areas in exploring new situations*

- H4 *analyses representations of data in order to make inferences, predictions and conclusions*
- H7 *interprets the results of measurements and calculations and makes judgments about reasonableness*
- H11 *uses mathematical argument and reasoning to evaluate conclusions drawn from other sources, communicating his/her position clearly to others.*

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Students can work toward achieving outcomes in the Data analysis and Measurement strands of the General Mathematics course.

The following tables show the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 Mathematics outcomes.

Streamwatch Manual section	Stage 6 General Mathematics outcomes in Data analysis (DA1, DA2, DA4)							
	P1	P2	P4	P7	P9	P11	H1	H11
Welcome		X	X	X	X	X	X	
Temperature	X				X	X		
pH	X				X	X		
Electrical conductivity	X				X	X		
Turbidity	X				X	X		
Dissolved oxygen	X				X	X		
Available phosphate	X				X	X		
Faecal coliforms					X	X		
Aquatic macroinvertebrates	X				X	X		
Water quality guidelines						X		X

Table 8a: Streamwatch applications to Stage 6 General Mathematics syllabus outcomes.

Streamwatch Manual section	Stage 6 General Mathematics outcomes in Measurement (M1)				
	P2	P7	H2	H4	H7
Welcome	X	X	X		
Temperature	X		X		
pH		X			X
Electrical conductivity		X			X
Turbidity		X			X
Dissolved oxygen		X			X
Available phosphorus		X			X
Faecal coliforms		X			X
Aquatic macroinvertebrates				X	
Water quality guidelines		X			

Table 8b: Streamwatch applications to Stage 6 General Mathematics syllabus outcomes.

3.5 Stage 6 Mathematics activity

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes.

- H4 *analyses representations of data in order to make inferences, predictions and conclusions*
- H7 *interprets the results of measurements and calculations and makes judgments about reasonableness*
- P9 *determines an appropriate form of organisation and representation of collected data*
- P11 *justifies his/her response to a given problem using appropriate mathematical terminology.*

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Description of activity

1. Using local area maps, estimate the school's catchment area and produce a scale drawing of a stream being monitored through the Streamwatch program. Explain the method you used to calculate this area.
2. With reference to information from available sources, estimate the amount of run off entering the stream from this catchment area. Justify the estimate.
3. Using the information collected as part of the Streamwatch program, present a report of your findings (using suitable graphs and statistics) on the state of the stream during the period of the investigation.

Criteria for assessment

Students submit their report and are assessed on their ability to:

- describe the water quality in the catchment through tabulated data and appropriate graphical representation
- identify the factors that might cause changes in the water quality in the catchment and use statistical analysis to identify anomalies in collected data
- communicate their research methods and justify their findings and conclusions.

4 Science

4.1 Introduction

Students studying 7–10 Science are expected to develop knowledge and understanding in areas of everyday life that have been affected by scientific developments. As part of this study students are expected to be able to assess the human impact on the interaction of biotic and abiotic features of the environment, and recognise the role of science in providing information about issues being considered and in increasing understanding of the world around them.

Undertaking the Streamwatch program gives students opportunities to achieve these skills through reflecting on the impact of humans and their technology on the environment. During their 7–10 Science course, students are required to undertake at least one substantial research project during each of Stage 4 and Stage 5. At least one project undertaken in each stage must involve hands-on practical investigation.

At least one Stage 5 project will be an individual task.

4.2 Stage 4 Science outcomes

The Streamwatch program provides opportunities for students to achieve the following Stage 4 Science outcomes. A student:

- 4.1 *identifies historical examples of how scientific knowledge has changed people's understanding of the world*
- 4.8 *describes features of living things*
- 4.13 *clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem*
- 4.14 *follows a sequence of instructions to undertake a first-hand investigation*
- 4.15 *uses given criteria to gather first-hand data*
- 4.16 *accesses information from identified secondary sources*
- 4.17 *evaluates the relevance of data and information*
- 4.18 *with guidance, presents information to an audience to achieve a particular purpose*
- 4.19 *draws conclusions based on information available*
- 4.22 *undertakes a variety of individual and team tasks with guidance*
- 4.23 *demonstrates confidence and a willingness to make decisions and to take responsible action*
- 4.24 *respects differing viewpoints on science issues and is honest, fair and ethical*
- 4.25 *recognises the relevance and importance of lifelong learning and acknowledges the continued impact of science in many aspects of everyday life.*

The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 4 Science outcomes.

Streamwatch Manual section	Stage 4 Science syllabus outcomes												
	4.1	4.8	4.13	4.14	4.15	4.16	4.17	4.18	4.19	4.22	4.23	4.24	4.25
Welcome				X				X					X
Temperature		X	X	X	X		X	X		X	X	X	
pH	X	X	X	X	X					X	X		
Electrical conductivity		X	X	X	X		X	X		X	X		
Turbidity		X	X	X	X		X			X	X	X	
Dissolved oxygen	X	X	X	X	X		X	X		X	X	X	
Available phosphate		X	X	X	X		X			X	X	X	
Faecal coliforms	X	X	X	X	X		X			X	X	X	
Aquatic macroinvertebrates		X		X	X		X	X		X	X	X	X
Water quality guidelines						X			X				

Table 9: Streamwatch applications to Stage 4 Science syllabus outcomes.

4.3 Stage 4 Science activity

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes:

- 4.1 *identifies historical examples of how scientific knowledge has changed people's understanding of the world*
- 4.8 *describes features of living things*
- 4.13 *clarifies the purpose of an investigation and, with guidance, produces a plan to investigate a problem*
- 4.14 *follows a sequence of instructions to undertake a first-hand investigation*
- 4.15 *uses given criteria to gather first-hand data*
- 4.16 *accesses information from identified secondary sources*
- 4.17 *evaluates the relevance of data and information*
- 4.18 *with guidance, presents information to an audience to achieve a particular purpose*
- 4.19 *draws conclusions based on information available*
- 4.22 *undertakes a variety of individual and team tasks with guidance.*

Context

As a Year 7–8 Science student you are required to perform a hands-on practical investigation for your Student Research Project. Address a problem relevant to your local environment, and using the Streamwatch black kit, undertake your investigation and present a report for assessment.

Description of activity

Working as a part of a team, produce a report outlining the testing methods you participated in as part of the Streamwatch program. The activity is based on the procedures outlined in the Streamwatch Manual. Make sure you and your team use the manual methods to ensure valid and reliable data. As you complete the activity you should use the scaffold supplied to direct your report.

The observations and data collected during your Streamwatch monitoring need to be recorded on the results sheet below. The results sheet is located in the 'Welcome' section of the Streamwatch Manual.

Results sheet

Name:

Site name:

Date sampled:

Time sampled:

Last rainfall:

Observations (visible pollution, wildlife present, odour etc.)

Test	Units	Result	Comments
dissolved oxygen (DO)	mg/L		
dissolved oxygen (DO)	% saturation		
temperature	°C		
pH	pH units		
electrical conductivity	µS/cm		
	mS/cm		
turbidity	NTU		
available phosphate	mg/L		
faecal coliforms	CFU/100mL		

Registered Streamwatch groups should enter data as soon as possible after sampling into the Streamwatch website at www.streamwatch.org.au

Report all unusual results or pollution incidents to your Regional Coordinator.

Risk assessment

Before conducting any activity you should be aware of the possible hazards:

- What are the possible hazards you could face when conducting your testing?
- Are you using any chemicals?
- What precautions should you take when using these chemicals?
- What is the procedure for finding out about the safety concerns surrounding the chemicals you use when performing Streamwatch monitoring?
- Have you informed the appropriate people about where and when you are going testing and for how long?
- Has someone in your excursion party got a mobile telephone and a list of emergency numbers for use if required?

Temperature

Use the method outlined in the Streamwatch Manual to test the temperature of the waterway. In your own words what are the steps you need to follow to measure the temperature of the waterway?

pH

What is meant by the term pH?

What equipment do you use to measure pH?

How did you measure the pH of the waterway?

Is the waterway acidic, neutral or alkaline?

List the factors near your sampling site that may impact on the pH of the waterway.

What sort of information might pH measurements indicate?

Electrical conductivity

What is meant by the term electrical conductivity?

What equipment do you use to measure electrical conductivity?

How did you measure the electrical conductivity of the waterway?

Is the waterway high in dissolved salts?

List the factors near your sampling site that may impact on the electrical conductivity of the waterway.

What sort of information might electrical conductivity measurements indicate?

Turbidity

What is meant by the term turbidity?

What equipment do you use to measure turbidity?

How did you measure the turbidity of the waterway?

Is the waterway high in sediment load?

List the factors near your sampling site that may impact on the turbidity level in the waterway.

What sort of information might turbidity measurements indicate?

Dissolved oxygen

What is meant by the term dissolved oxygen?

What equipment do you use to measure dissolved oxygen?

How did you measure the dissolved oxygen of the waterway?

Is the waterway high in dissolved oxygen?

List the factors near your sampling site that may impact on the level of dissolved oxygen in the waterway.

What sort of information might dissolved oxygen measurements indicate?

Nutrients

An excess of nutrients in a waterway can have detrimental impacts. Explain why that may be the case.

Available phosphate

What is meant by the term available phosphate?

What equipment do you use to measure available phosphate?

How did you measure the available phosphate of the waterway?

Is the waterway high in available phosphate?

List the factors near your sampling site that may impact on the level of available phosphate in the waterway.

What sort of information might available phosphate measurements indicate?

Faecal coliforms

What is meant by the term faecal coliforms?

What equipment do you use to measure faecal coliforms?

How did you measure the faecal coliforms of the waterway?

Why is it important to know whether or not there has been rain recently in the catchment area?

List the factors near your sampling site that may impact on the numbers of faecal coliform colonies in the waterway.

What sort of information might faecal coliform measurements indicate?

Aquatic macroinvertebrates

What is meant by the term aquatic macroinvertebrates?

What equipment do you use to measure aquatic macroinvertebrates?

How did you measure the level of aquatic macroinvertebrates in the water in your waterway?

List the factors near your sampling site that may impact on the numbers of macroinvertebrates in the waterway.

What sort of information might aquatic macroinvertebrate measurements indicate?

Water quality guidelines

Now that you have collected your data, read the section of the Streamwatch Manual titled 'Water quality guidelines'. Use the guidelines to evaluate the health of the waterway.

Criteria for assessment

Students submit their report and are assessed on their ability to:

- describe how they work in teams or as individuals on specific tasks
- follow a sequence of instructions to undertake a first-hand investigation
- use given criteria to gather first-hand data
- describe the water quality in the catchment through tabulated data and appropriate graphical representation
- evaluates the relevance of data and information
- accesses information from identified secondary sources
- draws conclusions based on information available
- identify the factors that might cause changes in the water quality in the catchment and use statistical analysis to identify anomalies in collected data
- answers the questions asked referring to their collected data and the Streamwatch manual
- communicate their research methods and justify their findings and conclusions and presents information to an audience to achieve a particular purpose.

4.4 Stage 5 Science outcomes

The Streamwatch program provides opportunities for students to achieve the following Stage 5 Science outcomes. A student:

- 5.1 *explains how social factors influence the development and acceptance of scientific ideas*
- 5.8 *relates the structure and function of living things to models, theories and laws*
- 5.11 *analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources*

- 5.13 *identifies a problem and independently produces an appropriate investigation plan*
- 5.14 *undertakes first-hand investigations independently with safety and competence*
- 5.15 *gathers first-hand data accurately*
- 5.16 *accesses information from a wide variety of secondary sources*
- 5.17 *explains trends, patterns and relationships in data and/or information from a variety of sources*
- 5.18 *selects and uses appropriate forms of communication to present information to an audience*
- 5.19 *uses critical thinking skills in evaluating information and drawing conclusions*
- 5.22 *plans, implements and evaluates the effectiveness of a variety of tasks independently and as a team member*
- 5.23 *demonstrates confidence and a willingness to make decisions and to take responsible actions*
- 5.24 *respects differing viewpoints on science issues and is honest, fair and ethical*
- 5.27 *acknowledges their responsibility to conserve, protect and maintain the environment for the future.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 5 Science outcomes.

Streamwatch Manual section	Stage 5 Science syllabus outcomes													
	5.1	5.8	5.11	5.13	5.14	5.15	5.16	5.17	5.18	5.19	5.22	5.23	5.24	5.27
Welcome					X				X					X
Temperature	X			X	X	X		X	X		X	X	X	
pH	X		X	X	X	X		X			X	X		
Electrical conductivity	X		X	X	X	X			X		X	X		
Turbidity	X			X	X	X		X			X	X	X	
Dissolved oxygen	X			X	X	X		X	X		X	X	X	
Available phosphate	X		X	X	X	X		X			X	X	X	
Faecal coliforms	X	X	X		X	X		X			X	X	X	
Aquatic macroinvertebrates	X				X	X		X	X		X	X	X	X
Water quality guidelines											X			

Table 10: Streamwatch applications to Stage 5 Science syllabus outcomes.

4.5 Stage 5 Science activity

Year 9–10 Science students are required to perform a hands-on practical investigation for a Student Research Project. This should address a problem relevant to the local environment and use readily available materials to undertake the investigation.

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes.

- 5.10 *assesses human impacts on the interaction of biotic and abiotic features of the environment*
- 5.11 *analyses the impact of human resource use on the biosphere to evaluate methods of conserving, protecting and maintaining Earth's resources*
- 5.13 *identifies a problem and independently produces an appropriate investigation plan*
- 5.14 *undertakes first-hand investigations independently with safety and competence*
- 5.15 *gathers first-hand data accurately*
- 5.16 *accesses information from a wide variety of secondary sources*
- 5.17 *explains trends, patterns and relationships in data and/or information from a variety of sources*
- 5.18 *selects and uses appropriate forms of communication to present information to an audience*
- 5.19 *uses critical thinking skills in evaluating information and drawing conclusions.*

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Context

You notice that there are no fish visible in a local creek and the vegetation near the creek is dying. You suspect that the water in the creek, although it looks clear, may be polluted. A chemical factory is situated near the creek and you suspect the factory could be a possible source of pollution. You decide to collect water samples from the creek and carry out tests to assess the quality of the water and the level of pollution.

How would you know whether the suspected pollutant in the creek was the fault of the chemical factory? Steep fines and criminal prosecution face people and companies who fail to safeguard the environment. The biggest problem is trying to prove who the perpetrator is or where the source of the pollution is coming from. The collection of base line data over an extended time frame can help identify when pollutants have entered the creek, the type of pollutant and therefore the possible source of the pollution.

Description of activity

Planning your field study

- 1) Design an experiment to test your hypothesis. In designing your experiment you need to be aware of the experimental and controlled variables and the importance of replicating your experiment to minimise human error.
- 2) Research information from various sources including the Internet, books and journals.
- 3) Obtain a map of your local area from your local Council or Library. Indicate on the map the positions of four different sites where you plan to collect water samples from to test the water quality.
- 4) Discuss the design of your experiment with your teacher before you begin your field study.

Conducting your field study

- 1) Make notes on the appearance of the water at each site, e.g. colour, smell, froth or scum, floating rubbish, how fast the water is flowing and in what direction.
- 2) Carry out the following tests on samples from each site:
 - temperature
 - pH
 - electrical conductivity
 - turbidity
 - dissolved oxygen
 - phosphorus
 - faecal coliforms
- 3) Present your results in the most suitable form.

Analysis of data and final conclusion

- 1) Discuss the results you obtained by:
 - stating your findings
 - preparing graphs and tables of your data which you can use to support your conclusions
 - proposing possible reasons for any unusual results
 - relating your investigation to its impact on society
 - stating whether or not your hypothesis was supported by your results
 - suggesting any modifications to your investigation that could improve the reliability of the results obtained.

Criteria for assessment

Students submit their report and are assessed on their ability to:

- describe how they work in teams or as individuals on specific tasks
- follow a sequence of instructions to undertake a first-hand investigation
- use given criteria to gather first-hand data

- describe the water quality in the catchment through tabulated data and appropriate graphical representation
- evaluates the relevance of data and information
- accesses information from identified secondary sources
- draws conclusions based on information available
- identify the factors that might cause changes in the water quality in the catchment and use statistical analysis to identify anomalies in collected data
- communicate their research methods and justify their findings and conclusions and presents information to an audience to achieve a particular purpose.

4.6 Stage 6 Senior Science outcomes

Preliminary Senior Science outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Preliminary Senior Science outcomes. A student:

- P1 *outlines the historical development of scientific principles, concepts and ideas*
- P2 *applies the processes that are used to test and validate models, theories and laws of science, with particular emphasis on first-hand investigations*
- P3 *assesses the impact of particular technological advances on science*
- P4 *identifies applications of science that affect society and the environment*
- P5 *identifies areas of current scientific research*
- P6 *identifies the origins of Earth's resources*
- P7 *explains relationships between organisms in the environment*
- P8 *describes reactions between compounds*
- P9 *describes the structure of body organs and systems*
- P10 *describes the effect of energy transfers and transformations*
- P11 *identifies and implements improvements to investigation plans*
- P12 *discusses the validity and reliability of data gathered from first-hand investigations and secondary sources*
- P13 *identifies appropriate terminology and reporting styles to communicate information and understanding in science*
- P14 *draws valid conclusions from gathered data and information*
- P15 *implements strategies to work effectively as an individual or as a member of a team*
- P16 *demonstrates positive values about and attitudes towards both the living and non-living components of the environment, ethical behaviour and a desire for a critical evaluation of the consequences of the applications of science.*

The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 Preliminary Senior Science outcomes.

Stage 6 Preliminary Senior Science syllabus outcomes																
Streamwatch Manual section	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16
Welcome											X	X	X	X	X	X
Temperature		X		X			X	X			X	X	X	X	X	X
pH		X		X		X		X			X	X	X	X	X	X
Electrical conductivity		X	X	X		X				X	X	X	X	X	X	X
Turbidity		X		X			X				X	X	X	X	X	X
Dissolved oxygen		X		X		X	X	X			X	X	X	X	X	X
Available phosphate		X		X		X	X	X			X	X	X	X	X	X
Faecal coliforms		X	X	X			X		X		X	X	X	X	X	X
Aquatic macro-invertebrates																
Water quality guidelines	X	X		X										X		

Table 11: Streamwatch applications to Stage 6 Preliminary Senior Science syllabus outcomes.

HSC Senior Science outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following HSC Science outcomes. A student:

- H1 *discusses advances in scientific understanding and technology that have changed the direction or nature of scientific thinking*
- H3 *assesses the contribution of scientific advances on the development of technologies*
- H4 *assesses the impacts of applications of science on society and the environment*
- H6 *describes uses of the Earth's resources*
- H7 *identifies effects of internal and external environmental changes on the human body*
- H8 *relates the properties of chemicals to their use*
- H9 *relates the structure of body organs and systems to their function*
- H10 *discusses ways in which different forms of energy and energy transfers and transformations are used*
- H11 *justifies the appropriateness of a particular investigation plan*
- H12 *evaluates ways in which accuracy and reliability could be improved in investigations*

- H13 *uses terminology and reporting styles appropriately and successfully to communicate information and understanding*
- H14 *assesses the validity of conclusions from gathered data and information*
- H15 *explains why an investigation is best undertaken individually or by a team*
- H16 *justifies positive values about and attitudes towards both the living and non-living components of the environment, ethical behaviour and a desire for a critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 HSC Senior Science outcomes.

Stage 6 HSC Senior Science syllabus outcomes															
Streamwatch Manual section	H1	H2	H3	H4	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16
Welcome										X	X	X	X	X	X
Temperature		X			X	X	X			X	X	X	X	X	X
pH		X			X		X			X	X	X	X	X	X
Electrical conductivity	X	X		X					X	X	X	X	X	X	X
Turbidity		X			X					X	X	X	X	X	X
Dissolved oxygen	X	X			X		X			X	X	X	X	X	X
Available phosphate	X	X		X	X		X			X	X	X	X	X	X
Faecal coliforms	X	X		X	X	X			X	X	X	X	X	X	X
Aquatic macro-invertebrates										X					
Water quality guidelines	X			X									X		

Table 12: Streamwatch applications to Stage 6 HSC Senior Science syllabus outcomes.

4.7 Stage 6 Senior Science activity

This activity can be used in conjunction with regular Streamwatch testing in order to achieve the following outcomes.

- P2 *applies the processes that are used to test and validate models, theories and laws of science, with particular emphasis on first-hand investigations*
- P3 *assesses the impact of particular technological advances on science*
- P4 *identifies applications of science that affect society and the environment*
- P7 *explains relationships between organisms in the environment*
- P8 *describes reactions between compounds*
- P11 *identifies and implements improvements to investigation plans*
- P12 *discusses the validity and reliability of data gathered from first-hand investigations and secondary sources*

- P13 *identifies appropriate terminology and reporting styles to communicate information and understanding in science*
- P14 *draws valid conclusions from gathered data and information*
- P15 *implements strategies to work effectively as an individual or as a member of a team*
- P16 *demonstrates positive values about and attitudes towards both the living and non-living components of the environment, ethical behaviour and a desire for a critical evaluation of the consequences of the applications of science.*

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Description of activity

Your local council has appointed you as an Environment Officer.

Plan and choose equipment or resources to perform a first-hand investigation to assess the impact of the release of domestic substances into an aquatic ecosystem in your local area. Monitor the quality of the water in the aquatic ecosystem to ensure that the Australian Drinking Water Guidelines, set out by the National Health and Medical Research Centre, are being met.

Criteria for assessment

Students submit their report and are assessed on their ability to:

- describe how they work in teams or as individuals on specific tasks
- follow a sequence of instructions to undertake a first-hand investigation
- use given criteria to gather first-hand data
- describe the water quality in the catchment through tabulated data and appropriate graphical representation
- evaluates the relevance of data and information
- accesses information from identified secondary sources
- draws conclusions based on information available
- identify the factors that might cause changes in the water quality in the catchment and explains relationships between organisms in the environment
- identifies appropriate terminology and reporting styles to communicate information and understanding in science.

4.8 Chemistry outcomes

Preliminary Chemistry outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Preliminary Chemistry outcomes. A student:

- P1 *outlines the historical development of major principles, concepts and ideas in chemistry*

- P2 *applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in chemistry*
- P3 *assesses the impact of particular technological advances on understanding in chemistry*
- P4 *describes applications of chemistry which affect society or the environment*
- P7 *describes chemical changes in terms of energy inputs and outputs*
- P8 *describes factors that influence the type and rate of chemical reactions*
- P9 *relates the uses of carbon to the unique nature of carbon chemistry*
- P10 *applies simple stoichiometric relationships*
- P11. *identifies and implements improvements to investigation plans*
- P12 *discusses the validity and reliability of data gathered from first-hand investigations and secondary sources*
- P13 *identifies appropriate terminology and reporting styles to communicate information and understanding*
- P14 *draws valid conclusions from gathered data and information*
- P15 *implements strategies to work effectively as an individual or as a member of a team*
- P16 *demonstrates positive values about, and attitude towards, both the living and non-living components of the environment, ethical behaviour and a desire for a critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 Preliminary Chemistry outcomes.

Streamwatch Manual section	Stage 6 Preliminary Chemistry syllabus outcomes											
	P1	P2	P3	P4	P7	P8	P11	P12	P13	P14	P15	P16
Welcome								X	X	X	X	X
Temperature		X		X	X	X	X	X	X	X	X	X
pH		X		X		X	X	X	X	X	X	X
Electrical conductivity		X		X			X	X	X	X	X	X
Turbidity		X		X			X	X	X	X	X	X
Dissolved oxygen		X		X			X	X	X	X	X	X
Available phosphate		X		X			X	X	X	X	X	X
Faecal coliforms		X	X				X	X	X	X	X	X
Aquatic macroinvertebrates												
Water quality guidelines	X	X										

Table 13: Streamwatch applications to Stage 6 Preliminary Chemistry syllabus outcomes.

HSC Chemistry outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following HSC Chemistry outcomes. A student:

- H1 *evaluates how major advances in scientific understanding and technology have changed the direction or nature of scientific thinking*
- H2 *analyses the ways in which models, theories and laws in chemistry have been tested and validated*
- H4 *assesses the impacts of applications of chemistry on society and the environment*
- H8 *assesses the range of factors which influence the type and rate of chemical reactions*
- H9 *describes and predicts reactions involving carbon compounds*
- H10 *analyses stoichiometric relationships*
- H11 *justifies the appropriateness of a particular investigation plan*
- H12 *evaluates ways in which accuracy and reliability could be improved in investigations*
- H13 *uses terminology and reporting styles appropriately and successfully to communicate information and understanding*
- H14 *assesses the validity of conclusions from gathered data and information*
- H15 *explains why an investigation is best undertaken individually or by a team*
- H16 *justifies positive values about and attitude towards both the living and non-living components of the environment, ethical behaviour and a desire for critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 HSC Chemistry outcomes.

Streamwatch Manual section	Stage 6 HSC Chemistry syllabus outcomes									
	H1	H2	H4	H8	H11	H12	H13	H14	H15	H16
Welcome					X	X	X	X	X	X
Temperature		X	X	X	X	X	X	X	X	X
pH		X	X	X	X	X	X	X	X	X
Electrical conductivity	X	X	X		X	X	X	X	X	X
Turbidity		X			X	X	X	X	X	X
Dissolved oxygen	X	X	X		X	X	X	X	X	X
Available phosphate	X	X	X		X	X	X	X	X	X
Faecal coliforms	X	X			X	X	X	X	X	X
Aquatic macroinvertebrates										
Water quality guidelines	X	X								

Table 14: Streamwatch applications to Stage 6 HSC Chemistry syllabus outcomes.

4.9 Physics outcomes

Preliminary Physics outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Preliminary Physics outcomes. A student:

- P4 *describes applications of physics which affect society or the environment*
- P12 *discusses the validity and reliability of data gathered from first-hand investigations and secondary sources*
- P13 *identifies appropriate terminology and reporting styles to communicate information and understanding in physics*
- P14 *draws valid conclusions from gathered data and information*
- P15 *implements strategies to work effectively as an individual or as a member of a team*
- P16 *demonstrates positive values about, and attitude towards, both the living and non-living components of the environment, ethical behaviour and a desire for a critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 Preliminary Physics outcomes.

Streamwatch Manual section	Stage 6 Preliminary Physics syllabus outcomes					
	P4	P12	P13	P14	P15	P16
Welcome		X	X	X	X	X
Temperature						
pH						
Electrical conductivity	X					
Turbidity						
Dissolved oxygen						
Available phosphate						
Faecal coliforms						
Aquatic macroinvertebrates						
Water quality guidelines						

Table 15: Streamwatch applications to Stage 6 Preliminary Physics syllabus outcomes.

HSC Physics outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following HSC Physics outcomes. A student:

- H1 *evaluates how major advances in scientific understanding and technology have changed the direction or nature of scientific thinking*
- H11 *justifies the appropriateness of a particular investigation plan*

- H12 *evaluates ways in which accuracy and reliability could be improved in investigations*
- H13 *uses terminology and reporting styles appropriately and successfully to communicate information and understanding*
- H14 *assesses the validity of conclusions from gathered data and information*
- H15 *explains why an investigation is best undertaken individually or by a team*
- H16 *justifies positive values about and attitude towards both the living and non-living components of the environment, ethical behaviour and a desire for critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 HSC Physics outcomes.

Stage 6 HSC Physics syllabus outcomes							
Streamwatch Manual section	H1	H11	H12	H13	H14	H15	H16
Welcome			X	X	X	X	X
Temperature							
pH							
Electrical conductivity	X						
Turbidity							
Dissolved oxygen							
Available phosphate							
Faecal coliforms							
Aquatic macroinvertebrates							
Water quality guidelines							

Table 16: Streamwatch applications to Stage 6 HSC Physics syllabus outcomes.

4.10 Biology outcomes

Preliminary Biology outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Preliminary Biology outcomes. A student:

- P1 *outlines the historical development of major biological principles, concepts and ideas*
- P2 *applies the processes that are used to test and validate models, theories and laws of science, with particular emphasis on first-hand investigations in biology*
- P3 *assesses the impact of particular technological advances on understanding in biology*
- P4 *describes applications of biology which affect society or the environment*
- P5 *describes the scientific principles employed in particular areas of biological research*

- P6 *explains how cell ultrastructure and the coordinated activities of cells, tissues and organs contribute to macroscopic processes in organisms*
- P7 *describes the range of organisms in terms of specialisation for a habitat*
- P8 *analyses the interrelationships of organisms within the ecosystem*
- P11 *identifies and implements improvements to investigation plans*
- P12 *discusses the validity and reliability of data gathered from first-hand investigations and secondary sources*
- P13 *identifies appropriate terminology and reporting styles to communicate information and understanding in biology*
- P14 *draws valid conclusions from gathered data and information*
- P15 *implements strategies to work effectively as an individual or as a team member*
- P16 *demonstrates positive values about and attitudes towards both the living and non-living components of the environment, ethical behaviour and a desire for a critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 Preliminary Biology outcomes.

Streamwatch Manual section	Stage 6 Preliminary Biology syllabus outcomes												
	P1	P2	P3	P4	P6	P7	P8	P11	P12	P13	P14	P15	P16
Welcome		X		X		X	X	X	X	X	X	X	X
Temperature		X		X	X	X	X	X	X	X	X	X	X
pH		X		X	X	X	X	X	X	X	X	X	X
Electrical conductivity		X	X	X	X	X	X	X	X	X	X	X	X
Turbidity		X		X	X	X	X	X	X	X	X	X	X
Dissolved oxygen		X		X	X	X	X	X	X	X	X	X	X
Available phosphate		X		X	X	X	X	X	X	X	X	X	X
Faecal coliforms		X		X	X	X	X	X	X	X	X	X	X
Aquatic macroinvertebrates							X						
Water quality guidelines		X		X	X								

Table 17: Streamwatch applications to Stage 6 Preliminary Biology syllabus outcomes.

HSC Biology outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following HSC Biology outcomes. A student:

- H1 *evaluates how major advances in scientific understanding and technology have changed the direction or nature of scientific thinking*
- H2 *analyses the ways in which models, theories and laws in biology have been tested and validated*
- H4 *assesses the impacts of applications of biology on society and the environment*
- H6 *explains why the biochemical processes that occur in cells are related to macroscopic changes in the organism*
- H7 *analyses the impact of natural and human processes on biodiversity*
- H8 *evaluates the impact of human activity on the interactions of organisms and their environment*
- H11 *justifies the appropriateness of a particular investigation plan*
- H12 *evaluates ways in which accuracy and reliability could be improved in investigations*
- H13 *uses terminology and reporting styles appropriately and successfully to communicate information and understanding*
- H14 *assesses the validity of conclusions from gathered data and information*
- H15 *explains why an investigation is best undertaken individually or by a team*
- H16 *justifies positive values about and attitudes towards both the living and non-living components of the environment, ethical behaviour and a desire for a critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 HSC Biology outcomes.

Stage 6 HSC Biology syllabus outcomes												
Streamwatch Manual section	H1	H2	H4	H6	H7	H8	H11	H12	H13	H14	H15	H16
Welcome			X	X	X	X	X	X	X	X	X	X
Temperature		X	X	X	X	X	X	X	X	X	X	X
pH		X	X	X	X	X	X	X	X	X	X	X
Electrical conductivity	X	X	X	X	X	X	X	X	X	X	X	X
Turbidity		X	X	X	X	X	X	X	X	X	X	X
Dissolved oxygen	X	X	X	X	X	X	X	X	X	X	X	X
Available phosphate	X	X	X	X	X	X	X	X	X	X	X	X
Faecal coliforms	X	X	X	X	X	X	X	X	X	X	X	X
Aquatic macroinvertebrates												
Water quality guidelines	X	X	X		X	X						

Table 18: Streamwatch applications to Stage 6 HSC Biology syllabus outcomes.

4.11 Earth and Environmental Science outcomes

Preliminary Earth and Environmental Science outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following Preliminary Earth and Environmental Science outcomes. A student:

- P2 *applies the processes that are used to test and validate models, theories and laws of science with particular emphasis on first-hand investigations in Earth and Environmental Science*
- P3 *assesses the impact of particular technological advances on understanding in Earth and Environmental Science*
- P4 *describes applications of Earth and Environmental Science which affect society or the environment*
- P5 *describes the scientific principles employed in particular areas of Earth and Environmental Science research*
- P6 *identifies the origins of Earth's resources*
- P7 *identifies and describes the physical and chemical features of the environment*
- P9 *describes and locates available resources in Australian environments*
- P10 *describes human impact on the local environment*
- P11 *identifies and implements improvements to investigation plans*
- P12 *discusses the validity and reliability of data gathered from first-hand investigations and secondary sources*
- P13 *identifies appropriate terminology and reporting styles to communicate information and understanding in Earth and Environmental Science*
- P14 *draws valid conclusions from gathered data and information*
- P15 *implements strategies to work effectively as an individual or as a member of a team*
- P16 *demonstrates positive values about, and attitudes towards, both the living and non-living components of the environment; ethical behaviour; and a desire for critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 Preliminary Earth and Environmental Science outcomes.

Streamwatch Manual section	Stage 6 Preliminary Earth and environmental science outcomes													
	P2	P3	P4	P5	P6	P7	P9	P10	P11	P12	P13	P14	P15	P16
Welcome									X	X	X	X	X	X
Temperature	X		X	X		X	X	X	X	X	X	X	X	X
pH	X		X	X	X	X	X	X	X	X	X	X	X	X
Electrical conductivity	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Turbidity	X		X	X			X	X	X	X	X	X	X	X
Dissolved oxygen	X		X	X	X	X	X	X	X	X	X	X	X	X
Available phosphate	X		X	X	X	X	X	X	X	X	X	X	X	X
Faecal coliforms	X	X	X	X				X	X	X	X	X	X	X
Aquatic macroinvertebrates														
Water quality guidelines	X		X	X				X						

Table 19: Streamwatch applications to Stage 6 Preliminary Earth and Environmental Science syllabus outcomes.

HSC Earth and Environmental Science outcomes

The Streamwatch program provides opportunities for students to work toward achieving the following HSC Earth and Environmental Science outcomes. A student:

- H1 *evaluates how major advances in scientific understanding or technology have changed the direction or nature of scientific thinking*
- H2 *analyses the ways in which models, theories and laws in Earth and Environmental Science have been tested and validated*
- H3 *assesses the impact of particular advances in Earth and Environmental Science on the development of technologies*
- H4 *assesses the impact of applications of Earth and Environmental Science on society and the environment*
- H5 *identifies possible future directions of Earth and Environmental Science research*
- H6 *evaluates the use of the Earth's resources*
- H7 *discusses geological, biological, physical and chemical evidence of the evolving Australian and world environments*
- H8 *describes models which can be used to explain changing environmental conditions during the evolution of Australia and other continents*
- H9 *evaluates the impact of resources utilisation on the Australian environment*
- H10 *assesses the effects of current pressures on the Australian environment*
- H11 *justifies the appropriateness of a particular investigation plan*
- H12 *evaluates ways in which accuracy and reliability could be improved in investigations*

- H13 *uses terminology and reporting styles appropriately and successfully to communicate information and understanding*
- H14 *assesses the validity of conclusions drawn from gathered data and information*
- H15 *explains why an investigation is best undertaken individually or by a team*
- H16 *justifies positive values about and attitudes towards the living and non-living components of the environment; ethical behaviour; and a desire for critical evaluation of the consequences of the applications of science.*

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The following table shows the relevant sections of the Streamwatch Manual that provide activities designed to allow students to meet Stage 6 HSC Earth and Environmental Science outcomes.

Stage 6 HSC Earth and environmental syllabus outcomes															
Streamwatch Manual section	H1	H2	H3	H4	H6	H7	H8	H9	H10	H11	H12	H13	H14	H15	H16
Welcome										X	X	X	X	X	X
Temperature		X		X	X		X		X	X	X	X	X	X	X
pH		X		X	X	X	X	X	X	X	X	X	X	X	X
Electrical conductivity	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Turbidity		X		X	X	X	X	X	X	X	X	X	X	X	X
Dissolved oxygen	X	X		X	X	X	X	X	X	X	X	X	X	X	X
Available phosphate	X	X		X	X	X		X	X	X	X	X	X	X	X
Faecal coliforms	X	X		X	X		X	X	X	X	X	X	X	X	X
Aquatic macro-invertebrates															
Water quality guidelines				X									X		

Table 20: Streamwatch applications to Stage 6 HSC Earth and Environmental Science syllabus outcomes.

5 Environmental Policy

5.1 Introduction

The NSW Department of Education and Training has developed an Environmental Education Policy based on the principles of ecologically sustainable development. This policy is mandatory for all NSW government schools and promotes active participation by students in improving the school and global environment.

Streamwatch is a school and community action program that enables participants to work with the local government and community to investigate practical and real life situations relating to the environment. The Streamwatch program provides opportunities for students to develop into effective and committed environmental citizens, a key aim of the Environmental Education Policy.

All NSW government schools are required to develop a School Environmental Management Plan (SEMP) for the whole school community. It is suggested that schools try to involve the local community, environment groups and local government. The school's involvement in Streamwatch can assist in developing a broadly consultative SEMP.

5.2 Environmental Policy Focus Areas

The Environment policy sets out three major focus areas:

1. Curriculum
2. Management of resources
3. Management of school grounds (e.g. testing run off into local waterways).

The Streamwatch program supports the implementation of the new environmental education policy for schools and the practical application of the major focus areas.

The following table shows how sections of the Streamwatch Manual meet the focus areas of the Environmental Policy.

Environmental policy	Curriculum	Management of resources: water resources	Management of school grounds
Welcome			
Temperature	X	X	X
pH	X	X	X
Electrical conductivity	X	X	X
Turbidity	X	X	X
Dissolved oxygen	X	X	X
Available phosphate	X	X	X
Faecal coliform	X	X	X
Aquatic macroinvertebrates	X	X	X
Water quality guidelines		X	

Table 21: Streamwatch applications to Environmental Education Policy.

Streamwatch is a community and schools environmental education and action program that raises awareness of the natural environment by monitoring water quality in local waterways.

The Streamwatch program was established by Sydney Water in 1990 and is now delivered throughout Sydney Water's area of operations and Sydney's drinking water catchments, in partnership with the Sydney Catchment Authority.

Streamwatch is part of the national community water quality monitoring network known as Waterwatch. Waterwatch is implemented outside of the Sydney Water area of operations and Sydney drinking water catchments, by various partner organisations. In NSW these partners are the Catchment Management Authorities (CMAs).

For further details on the Streamwatch program visit the Streamwatch website at www.streamwatch.org.au. If you wish to contact the Streamwatch Coordinator for your local area directly, their contact can be found at www.streamwatch.org.au/contacts.

Sydney Water provides educators with a range of educational resources free of charge. These cater for both primary and secondary levels of education. For more information please visit the Sydney Water website at www.sydneywater.com.au or call Customer Enquiries on 13 20 92.

