



Chapter 3: A scope & sequence for water education K–10

Current NSW Board of Studies syllabuses do not mandate the achievement of water education outcomes of the type specified by Sydney Water in Table 1.1, Chapter 1. There are many opportunities for water education in existing syllabuses and it is believed that most schools do consistently address water issues via formal or informal programs of water education. However, there is no publicly available document outlining an explicit scope and sequence for water education for all schools, covering the school years K–10.¹⁵ In the absence of such a guide it is difficult to provide advice to schools, assess the effectiveness of the water education that does occur or make recommendations for future resource development and design evaluation for the resources that result from this.

This chapter outlines a possible scope & sequence for water education K–10 that integrates the outcomes and content requirements of existing Board of Studies syllabuses and the DET Environmental Education Policy for Schools. It also provides detailed resource development advice to support the ten recommendations contained in the Executive Summary. The chapter is divided into a primary school and a secondary school section and within these is organised according to the five Stages of schooling used in Board of Studies Syllabuses:

Stage 1	Years 1 – 2
Stage 2	Years 3 – 4
Stage 3	Years 5 – 6
Stage 4	Years 7 – 8
Stage 5	Years 9 – 10

The chapter contains the results of the teacher consultation workshop hosted by Curriculum K–12 Directorate on 14 December 2005.

The chapter contains some comment on existing Sydney Water educational resources, from the viewpoint of their usefulness in developing future on-line resources attuned to the approach recommended in this report, although the main review of current hard copy and online materials is contained in Chapter 4.

¹⁵ The recently announced NSW government decision to revise the K–6 Science and Technology syllabus may provide an opportunity for including explicit water education outcomes

Part A. Primary School

Water education in primary school is best undertaken by integrating across the key learning areas (KLAs) in the manner shown by the Connected Outcomes Groups (COGs) that have been developed by Curriculum K–12 Directorate. Within a COGs approach, the leading syllabuses for water education content are HSIE K–6 and Science & Technology K–6. The strands and sub-strands of these syllabuses that are most relevant for water education are:

HSIE K–6 strands and sub-strands

- | | |
|-------------------------------|---|
| Environments | <ul style="list-style-type: none">• <i>Patterns of Place & Location</i>• <i>Relationship with Places</i> |
| Social Structures and Systems | <ul style="list-style-type: none">• <i>Resource Systems</i>• <i>Roles, Rights and Responsibilities</i> |

Science & Technology K–6 strands and sub-strands

- | | |
|---------|---|
| Process | <ul style="list-style-type: none">• Investigating• Designing and making |
| Content | <ul style="list-style-type: none">• Earth and its surroundings• Living things• Built environments• Products and services |

Suggested water education activities that support the student outcomes of each of these strands and sub-strands and the development of values for water responsible citizenship, are given in tables for Stages 1, 2, and 3 over the following pages. As demonstrated by the Sydney Water kit *Every Drop Counts*, the other key learning areas can be integrated with HSIE and Science & Technology to create complete activities or units of work.

Perhaps the greatest untapped potential for using the other key learning areas in water education is in mathematics. There is a significant mathematical component in water education, not only in regard to number but also measurement and data, space and geometry. Volumes, percentages, stocks and flows and the need to use and interpret very large quantities (often graphically) provide many valuable opportunities for using maths as a leading KLA for water education.

Concepts of scale may be challenging in the early years. For example, Stage 1 students may find large-scale catchment concepts difficult to visualise or comprehend but be quite capable of recognising the same concepts at the scale of the school roof, playground, garden and frog pond. If this is correct, it provides support for beginning with small scale case studies in the school and home in Stage 1 and extending this to large scale case studies of the whole Sydney catchment and Sydney Water distribution system in Stage 2 and beyond.

Stage 1

Theme: A sense of belonging¹⁶

In Stage 1 the focus is on students:

- developing a sense of belonging to and caring for the local community and environment;
- understanding the place and function of water in this environment (for many years teachers have used the Board of Studies Unit “Wet and Dry Environments” for this);
- understanding the importance of water in their own lives and the community;
- understanding and applying simple rules of responsible water use at home, at school and in the community.

Suggested water education activities that support the student outcomes of the relevant strands and sub-strands of HSIE K–6 and Science & Technology K–6 for Stage 1 are provided in the tables on the following page. Board of Studies Foundation Statements for the same syllabuses are provided in Appendix 3 of this report with relevance to water education highlighted in bold.

In addition to within-class activities, water education in Stage 1 may be fostered by whole school activities, associated with the School Environment Management Plan, including special events and peer support mentoring of Stage 1 students by Stage 3 students in regard to the school’s Water Action Plan.

Teachers consulted for this report recommended the provision of resources which develop and model knowledge, values and behaviour through:

- story;
- interactive games;
- school water conservation activities; and
- a design-and-make task suitable for this age group.

Teachers’ specific on-line resource requests include:

- information about water conservation activities and scenarios for school sites to support a *Water wise* design-and-make task suitable for Stage 1;
- an interactive online game to encourage students to consider and make decisions about wise water use at home and school;
- new on-line story book characters in various water use situations (similar to the ‘Lester and Clyde’ series, is one suggestion);

¹⁶ To encourage teachers and resource writers to actively question and investigate the scope and sequence of water education, five themes are proposed for Stages 1 to 5. The themes are based on a variety of sources including discussions with teachers and curriculum consultants, direct experience with previous programs such as the Porters Creek Wetland Kit and David Sobel’s *Beyond Ecophobia* 1996 published by The Orion Society. They are not meant to imply the existence of precise boundaries between stages.

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- website activities to extend *Grubbit fights back*, or its replacement (suggestions include: an electronic pledge and writing tasks with click and drag images to help students illustrate their work);
- on-line templates, information and graphics to assist students to develop their own *Water wise* books or websites as an on-line publishing task;
- teaching notes, including information on school water conservation activities and a design-and-make task, to be provided with curriculum links and teaching and learning activities for all materials.

It is suggested that this work is undertaken following and informed by the materials developed for Stages 2 to 5.

Suggested Water Education Activities in support of HSIE Stage 1 Syllabus Outcomes

<i>Patterns of Place & Location</i>	<i>Relationship with Places</i>	<i>Resource Systems</i>	<i>Roles, Rights & Responsibilities</i>
<p>ENS1.5 Compares and contrasts natural and built features in their local area and the ways in which people interact with these features.</p>	<p>ENS1.6 Demonstrates an understanding of the relationship between environments and people.</p>	<p>SSS1.7 Explains how people and technologies in systems link to provide goods and services to satisfy needs and wants.</p>	<p>SSS1.8 Identifies roles and responsibilities within families, schools and the local community, and determines ways in which they should interact with others.</p>
<p>Investigates natural and built catchments at school and home (including during rainfall – appropriate clothing & OH&S required).</p> <p>Studies the species and habitats of wet and dry environments, first hand & through literature, etc – link to INVS1.7, ESS1.6, LTS1.3</p>	<p>Investigates sources and consequences of water pollution in natural and built catchments and ways of reducing pollution (litter, turbidity, ...). Use simpler Junior Waterwatch (or Streamwatch) tests. Link to S&T Investigating (INVS1.7)</p>	<p>Explores the three urban water systems at school or home: potable supply, wastewater treatment and stormwater – link to DMS1.8 and ESS1.6.</p>	<p>Learns and applies simple water conservation and catchment protection rules and practices at school and home.</p> <p>Helps implement actions of the School Environment Management Plan (ideally in connection with students in Stages 2 & 3 ... i.e. whole school approach)</p>

Suggested Water Education Activities in support of SciTech Stage I Syllabus Outcomes

<i>Process Outcomes</i>		<i>Content Outcomes</i>			
<i>Investigating</i>	<i>Designing and Making</i>	<i>Earth and Its Surroundings</i>	<i>Living Things</i>	<i>Built Environments</i>	<i>Products and Services</i>
INVS1.7 Conducts guided investigations by observing, questioning, predicting, collecting and recording data, and suggesting possible explanations.	DMS1.8 Develops and implements own design ideas in response to an investigation of needs and wants.	ESS1.6 Identifies and describes ways in which people and other living things depend upon the earth and its environments.	LTS1.3 Identifies and describes ways in which living things grow and change.	BES1.1 Creates, modifies or models built environments to suit the needs of users.	PSS1.5 Grows, makes or processes some products using a range of techniques and materials.
Investigates water and gross water pollution in relation to the topics under ENS 1.6, LTS1.3, BES1.1, PSS1.5.	Design task related to BES1.1, PSS1.5 and using information from the other HSIE and S&T content outcomes.	Explores the three urban water systems at school or home: -potable supply, -wastewater & -stormwater. Refer to SSS1.7.	Investigates the functions of water for living things. Investigates water in the life cycle of a species;	Creates, models or modifies water systems and water saving methods at school or home.	Plans a low-water use indoor or outdoor garden or develops a self sufficient watering system (one that does not use 'town' water).

Stage 2

Theme: Caring for catchments and water conservation

In Stage 2 the focus is on students:

- caring for catchments and water conservation at school, home and in the community;
- understanding the function and relations between the three urban water systems: potable water supply; wastewater and stormwater;
- extending their activities as water responsible citizens to undertake water audits at school and home (or elsewhere in the community), evaluate the audit results and assist Stage 3 students develop, implement and monitor sustainable water use proposals for the School Environmental Management Plan;
- developing a concept of water footprint as part of the larger concept of ecological footprint.

In this stage, students are capable of understanding catchment concepts and water supply issues at local to regional scales, analysing data, undertaking simple scientific investigations and design tasks and engaging in the formulation of rules and new approaches to sustainable water use.

To provide a context for this work, students need access to:

- graphic and operational information about the Sydney water supply catchment (from Sydney Catchment Authority);
- the potable water, wastewater and stormwater systems of Sydney;
- ways to investigate the school site as a managed catchment (with ability to calculate water inputs and outputs); and
- simplified information on Total Water Cycle Management (including current approaches in Water Sensitive Urban Design).

As this kind of information is also required in later stages, one of the important questions for resource designers to contemplate is how to make the relevant parts available at the appropriate level of sophistication for different stages.

Teachers consulted for this report recommended the development of on-line resources for Stage 2 that specifically include:

- data, maps, plans, photographs or video, animated graphics and explanatory notes on the water supply catchment, treatment and distribution systems, showing the links to homes and businesses, suitable for stage 2;
- home, school and business case studies and interactive monitoring tools to present and assist students assess water usage, waste water treatment and recycling that model 'best practice' -- include on-line data and calculator;
- Quality Teaching lesson plans and assessment and reporting guides in relation to the above resources.

Resources or units of work for Stage 2 should emphasise maths concepts and skills.

Suggested water education activities that integrate the student outcomes of the relevant strands and sub-strands of HSIE K–6 and Science & Technology K–6 Stage 2 are provided in the tables on the following page.

Suggested Water Education Activities in support of HSIE Stage 2 Syllabus Outcomes

<i>Patterns of Place and Location</i>	<i>Relationship with Places</i>	<i>Resource Systems</i>	<i>Roles, Rights and Responsibilities</i>
ENS2.5 Describes places in the local area and other parts of Australia and explains their significance.	ENS2.6 Describes people’s interactions with environments and identifies responsible ways of interacting with environments.	SSS2.7 Describes how and why people and technologies interact to meet needs and explains the effects of these interactions on people and the environment.	SSS2.8 Investigates rights, responsibilities and decision-making processes in the school and community and demonstrates how participation can contribute to the quality of their school and community life.
Investigates the Sydney Water Supply catchment and distribution system or the local stormwater catchment through maps, photos, models and fieldwork. Studies aquatic species or habitats within or affected by the Sydney Water Supply catchment or the local stormwater catchment, first hand & through literature, etc – link to INVS2.7, LTS2.3	Investigates methods of catchment management used by Sydney Catchment Authority or the local council – link to SSS2.8. Uses tests from Junior Waterwatch (or Streamwatch) to identify healthy or unhealthy aquatic habitats. Link to INVS2.7.	Explores the three urban water systems managed by Sydney Water: <ul style="list-style-type: none"> • potable water supply, • wastewater, and • stormwater. Investigates water savings methods for residential and industrial areas. Link to DMS2.8 and SSS2.8.	Discusses and considers alternatives to the water conservation and catchment protection rules and practices in Sydney (any scale). Undertakes water audits or other monitoring for the School Environment Management Plan (ideally in connection with students in Stages 2 & 3 ... i.e. whole school approach).

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Suggested Water Education Activities in support of SciTech Stage 2 Syllabus Outcomes

<i>Process Outcomes</i>		<i>Content Outcomes</i>			
<i>Investigating</i>	<i>Designing and Making</i>	<i>Earth and Its Surroundings</i>	<i>Living Things</i>	<i>Built Environments</i>	<i>Products and Services</i>
INVS2.7 Conducts investigations by observing, questioning, predicting, testing, collecting, recording and analysing data, and drawing conclusions.	DMS2.8 Develops, implements and evaluates ideas using drawings, models and prototypes at appropriate stages of the design process.	ESS2.6 Identifies some of the features of the solar system and describes interactions that affect conditions on earth.	LTS2.3 Identifies and describes the structure and function of living things and ways in which living things interact with other living things and their environment.	BES2.1 Creates, models and evaluates built environments, reflecting consideration of functional and aesthetic factors.	PSS2.5 Creates and evaluates products and services, considering aesthetic and functional factors.
Undertakes an authentic investigation of a water supply or treatment or aquatic habitat issue within the Sydney Water catchment.	Undertakes a design task related to BES2.1, PSS2.5 and using information from the other HSIE and S&T content outcomes.	Explores the role of the sun in the earth's water cycles – link to SSS2.7.	Describes the main elements and processes in an aquatic habitat. Uses Streamwatch tests to identify healthy and unhealthy aquatic habitats.	Creates, models or modifies the Sydney water supply and treatment system or part of it.	Develops a water saving or purifying device or method for a home, school or larger catchment.

Stage 3

Theme: Leaders in Water Responsible Citizenship

In Stage 3 the focus is on students:

- as leaders in their schools developing a strong sense of being custodians for the environment;
- making informed decisions, now and for the future, about how they use water – at school, in the community and at home;
- undertaking independent investigations of water issues;
- reviewing the way that water has traditionally been classified into different types in different parts of the urban water cycle (rain vs potable water vs stormwater vs wastewater) and understanding that sustainable management requires recognition of a single water cycle (This aligns with the Quality Teaching element of Problematic Knowledge as well as Deep Knowledge.¹⁷);
- assisting in the development, implementation and review of the Water Action Plan of the School Environment Management Plan (potentially in connection with a design and make task); and
- working in a peer support role to the younger students in the school.

These activities and investigations are placed in a global context in classroom studies in both HSIE and S&T. An outline of the activities and their links to Stage 3 HSIE and SciTech outcomes is provided in the tables on the following pages.

Teachers consulted for this report recommended the continued use, but further development, of:

- Streamwatch
- Every Drop Counts in Schools

Teachers suggested that Sydney Water consider broadening the conceptual framework of Streamwatch so that more schools are encouraged to take it up as part of water auditing for School Environmental Management Plans (i.e. considering the school as a rainwater catchment). If this approach is taken, it may be valuable to place a link to the Streamwatch website on the EDC web page. It was also requested that Sydney Water consider the provision of Streamwatch kits at a lower cost.

Teachers also suggested that Sydney Water further develop *Every Drop Counts* (EDC) into an on-line Quality Teaching program for Stages 2 and 3 by creating activities linked to HSIE and SciTech outcomes. While the Stage 2 focus would be on water audits at school, the Stage 3 focus would be investigating water use issues and impacts from the perspectives of science, technology and HSIE, and developing actions for the School Environmental Management Plan.

¹⁷ Each of the focus points in this and the other sections can profitably be related to the Quality Teaching elements. For example good Water Action Planning encourages significant Higher Order Thinking.

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The leadership theme of Stage 3 would also provide the basis for a Sydney Water award or recognition scheme for school water action plans and results and for initiatives of individual students and groups of students at school, home and the community.

The Watertight program offered to schools by the Observatory Hill Environmental Education Centre, which uses a number of Sydney Water resources, was considered to be particularly valuable. It was suggested that Sydney Water consider utilising the Watertight program as a model for professional development for school staff: This one-day, whole-school water auditing and planning activity uses Sydney Water and other resources to assist water auditing and water action planning for the SEMP. A particular strength of the program is the teacher professional development that occurs with the whole school staff as a result of the pre-, during- and post-event activities. Another potential resource for teacher professional development is the Backyard to Bush facility at Taronga Zoo and the talented staff who run it.

Suggested Water Education Activities in support of HSIE Stage 3 Syllabus Outcomes

<i>Patterns of Place and Location</i>	<i>Relationship with Places</i>	<i>Resource Systems</i>	<i>Roles, Rights and Responsibilities</i>
ENS3.5 Demonstrates an understanding of the interconnectedness between Australia and global environments and how individuals and groups can act in an ecologically responsible manner.	ENS3.6 Explains how various beliefs and practices influence the ways in which people interact with, change and value their environment.	SSS3.7 Describes how Australian people, systems and communities are globally interconnected and recognises global responsibilities, cultural influences and their contribution to Australian identities.	SSS3.8 Explains the structures, roles, responsibilities and decision-making processes of State and federal governments and explains why Australians value fairness and socially just principles.
Applies the concept of water footprint (from ESS3.6) to water supply, wastewater and stormwater systems of Sydney and other global cities and rural areas. Discusses the meaning of ecologically sustainable water use by comparing Sydney with other communities, globally – link to INVS3.7, DMS3.8, ESS3.6.	Investigates water values and uses in a variety of cultures and their relation to the concept of ecological sustainability (ENS3.5).	Reports international case studies of ecologically sustainable or unsustainable school water systems. Discusses ways in which Australia can contribute to ecologically sustainable water supply and use globally.	Using Stage 2 water audits and data and advice from Sydney Water and the local council, develops, reviews & revises the water action plan of the School Environment Management Plan (ideally in connection with students in Stages 2 & 3 ... i.e. whole school approach). Discusses the question “Who owns and manages Sydney’s water supply?”. Compares Sydney with other communities, globally.