

#### 4. People and the Lakes Activities

Activity title	Curriculum level	Curriculum link	Environmental education aspect	Page
4a Uses of the Lakes	Any level	Social Studies	About	113
4b Lakes Use Analysis	L 3–5	Social Studies	About	114
4c Water Around the World	L 2–5	Social Studies/ English		115
4d Bioaccumulation	L 3–5	Science	About	118
4e Impact of Industry: 1	L 4–5	Social Studies/ English	About	121
4f Impact of Industry: 2	L 3–5	Social Studies/ English	About	124
4g Impact of Industry: 3	L 3–5	Social Studies	About	126
4h Impact of Industry: 4	L 3–5	Social Studies/ English	About	127
4i Stormwater Problem	Any level	Social Studies/ English/Science	About	133
4j Watery Wastes	Any level	Social Studies/ English/Science	About, In	135
4k Stormwater	Any level	Social Studies/ English/Science	About	137
4l Pollution – What Happens?	Any level	English	About	142
4m Water Pollution – Nutrient, Biological, Toxic (NBT)	L 4–5	Science/English	About	143

4n Slogan	L 3–5	English	About, For	147
4o Lifestyles and Personal Choices	Any level	Social Studies/ English	For	148
4p Scenario	Any level	Social Studies/ English	About	150
4q S.O.S. – Save Our Streams	Any level	Science/ Social Studies/ English	About, In	155

### Relevant resources:

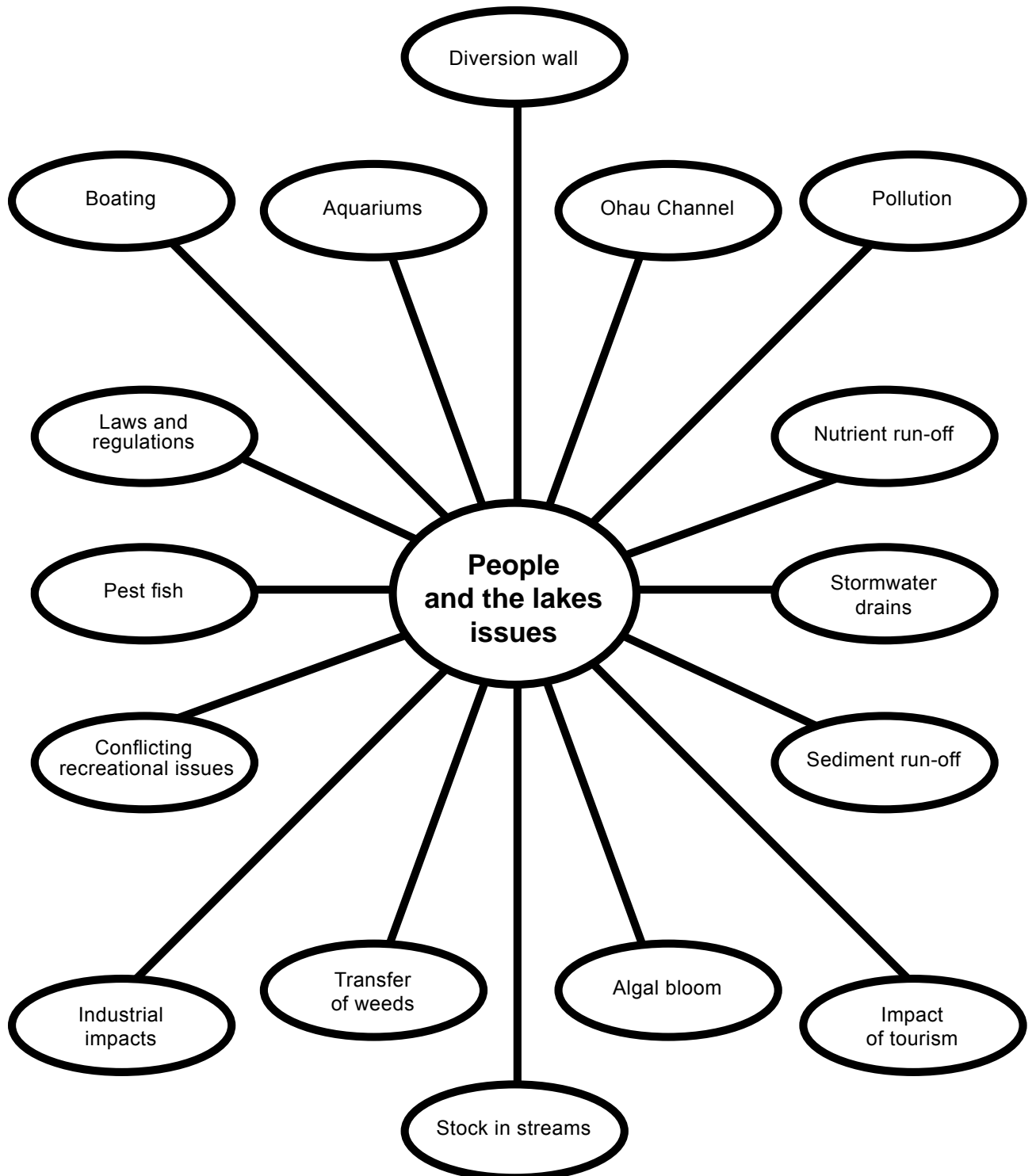
- Caring for Our Land – video 162 – Department of Conservation Conservancy Office
- Sustainable Agriculture and Water Quality– video 154 – Department of Conservation Conservancy Office
- The Impact of Forestry on Aquatic Resources – video 155 – Department of Conservation Conservancy Office
- Invaders in Paradise – video 144 – Department of Conservation Conservancy Office
- [www.h2ouse.org](http://www.h2ouse.org)
- [http://nwp.rsnz.org/content/Pollution\\_Detectives/projects\\_pollutiondetective.htm](http://nwp.rsnz.org/content/Pollution_Detectives/projects_pollutiondetective.htm)
- [www.watercare.net/wll](http://www.watercare.net/wll)
- [www.protectyourwaters.net/prevention\\_generic.php](http://www.protectyourwaters.net/prevention_generic.php)
- Waioira – Environment Bay of Plenty teachers resource – sections 3-5
- Rotorua Museum Education Resources
  - » Te Arawa – Moi Maketu ki Tongariro
  - » Grandparents photo kit
  - » History of Tourism Rotorua Timeline
- Wastewater-Rotorua District Council resource
- Environment Bay of Plenty Fact sheets on Rotorua Lakes
- In the footsteps of Kahumatamomoe Video/DVD
- Pollution Busters newsletter # 7 Stormwater
- Pollution Busters newsletter # 12 Water
- Pollution Busters newsletter # 14 Lakes
- Pollution Busters newsletter # 16 Weeds
- Pollution Busters newsletter # 24 Wetlands
- Starters & Strategies Issue 66 2005 June
- Starters & Strategies: <http://www.teachingonline.org/riverslakes.html>
- Learning Media – Connected Series

- Connected 2, 2002
- Learning Media – readers
  - » Lake Life, Sharon Holt, ISBN 0790310104 shows support plants, animals, bacteria – and even people. This text examines the importance of lakes and explores some of the potential threats to this precious resource.
  - » The World of Water, Susan Paris, ISBN 0 7903 0458 9 Water is one of the most important resources on Earth. This book explains where water comes from and how it gets to our homes. It also explores pollution and the importance of water conservation.
  - » Water – Item 88136 – This picture series has been planned for generating discussion and written work as part of the language programme. Each picture depicts some aspect of water, for example, in the home, at play, and for recreation.
  - » A Fishy Mystery, Anna MacKenzie, Item No. 30444 A group of children discover some dead fish floating in the local river and they are determined to find out what's killing them. They started by asking their teacher for help, then they conduct some research of their own.
- RSNZ – Alpha Series – [www.rsnz.org/education/alpha](http://www.rsnz.org/education/alpha)
  - » Alpha 109 – Tourism and The Environment



# People and the Lakes - Issues

This brainstorm highlights some of the issues relating to People and the Lakes; you may find others as you work through your selected activities. Many also link to other sections.



Templates 4–10 are useful tools for guiding students from the issues through to action.

# People and the Lakes

## ~ Action Ideas (see page 12)

- Litter collection
- Riparian planting
- Stormwater labelling e.g. I only drain rain/fish icon
- Cleaning stormwater grates
- Pamphlets, brochures, posters etc highlighting an issue
- Signs
- Letter writing/lobbying
- Advertising
- Slogans
- Surveys
- Public education
- Boat cleaning days
- Radio – advertising/item/reporting
- Newspaper article
- Tree planting - anywhere suitable
- Stalls or display at local events either school or community based
- Advertise results of surveys – school foyer, newsletter, local library etc
- Beautify lake edge
- Organise a community event around an issue

# Activity 4a Uses of the Lakes

## Curriculum links

## Social Studies

## Environment Education – about

Any level



Social Studies

## Resources required

- Template 1, Venn Diagram with the categories then, both, now
- Photopack

## Prior learning

- 3a Knowledge map
- 3d Mourea: then and now
- 3e Lakes history

## Method

- 1 Brainstorm what students think are some of the “past” uses of the lakes (activities 3a, 3d, 3e may help this process).
- 2 Also brainstorm present uses of the lakes.
- 3 In groups, sort the ideas into then/both/now lake uses and display on a Venn diagram .
- 4 Discuss changes over time and any implications for the past or present environment.
- 5 Reflection  
Having discussed the implications for the environment consider:
  - What actions might have been taken?
  - How would these actions have been achieved?
  - How would these actions have helped the environment?

## Possible next steps

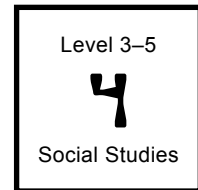
- 3h The Lakes: Now and Then

# Activity 4b Lakes Use Analysis

## Curriculum links

## Social Studies

## Environment Education – about



## Resources required

- Ideas and information gathered from 4a Uses of the lakes.
- Y Chart (Template 2)
- Triangular negotiation chart (Template 3)

## Prior learning

- 4a Uses of the lakes

## Method

- 1 Discuss 4a Uses of the lakes.
- 2 In groups/pairs use a Y Chart (Template 2) to put as many uses as possible under the categories: recreational, cultural and economic.
- 3 Onto the triangular negotiation chart (Template 3) list the environmental impacts for each of the above categories. Negotiate which category has the greatest environmental impact and why – write this into the centre of the triangle.
- 4 Share group ideas with the class.
- 5 Reflection
  - Knowing which category has the greatest environmental impact on the lakes, brainstorm possible solutions to identified issues
  - What can we do to reduce negative environmental impact on the lakes?

## Possible next steps

Take on roles reflected in a lake activity, i.e. water skiing – a water skier versus an environmentalist, and debate the pros and cons of the activity.

Research what can be done to reduce negative environmental impact.



# Activity 4c Water Around the World

**Curriculum links**

**Social Studies**

**English**

Level 3–5

4

Social Studies

## Resources required

- Photopack cards – ideas for a set of cards to be developed by your class

## Prior learning

- 4b Lakes Use Analysis

## Method

- 1 In groups, using the base set of cards attached, either draw or find appropriate pictures and make up a set for your group.
- 2 Explore how different cultures use and value water (with older students, the uses could be categorised as in 4b Lakes Use Analysis).
- 3 Share the findings with the rest of the class.
- 4 Discuss in what way this part of New Zealand is unique in its access to and use of water, as compared to many different cultures around the world.
- 5 Reflection

Having considered water uses around the world:

- How important do you think water as a resource is to New Zealand's future?
- Do we in New Zealand value water enough?
- Māori regard water as a taonga – do you believe this is true of most countries?
- How can we help people to realise that water is a taonga?

Someone living on ice	A Pacific Islander
A farmer	An Aboriginal living in the desert
A person living on a houseboat	Trampers
Staying at a bach	Shopkeeper

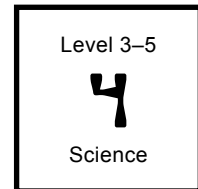
Living in an apartment	People fishing
People living in a flooded area	Seafarers many years ago

# Activity 4d Bioaccumulation - Chemical Pollution

Curriculum links

Science

Environment Education – about



## Resources required

- Oil – any variety, e.g. sunflower
- 3 beakers per group – labelled 1, 2 and waste
- Tube of oil based artist paint
- Food colouring
- Eye dropper
- 6 paper fish per group

## Prior learning

- 6g Who Eats What/Whom?

## Teacher's notes: Bioaccumulation

In the past, scientists were more concerned with visible forms of water pollution; the large quantities of raw sewage and hazardous wastes being dumped into our fresh water. However, a large proportion of pollution is invisible. Thousands of chemicals are present in water and sediments – some are toxic, some build up in the food chain and become toxic, and some are toxic when combined with other chemicals. Some chemicals have a tendency to bio-accumulate.

Bioaccumulation is the 'building-up' of a chemical in an organism's body. These chemicals are usually fat soluble so are stored. Water soluble chemicals can be excreted so don't tend to accumulate. All living things tend to be built from very similar chemicals, so they are all likely to accumulate similar substances and be affected by them in similar ways.

Examples of fat soluble chemical contaminants include PCB's, DDT and dioxin.

The following is a list of chemicals that might bio-accumulate:

- Food we eat that has been sprayed with insecticide so it looks appealing.
- Dairy products from cows whose hay and other food has been sprayed with herbicides.
- Careless handling of chemicals (pesticides, paints, petroleum products) so they find their way into our food and water supply.
- Eating fish from contaminated water. Pollutants could come from runoff from farms, lawns, and gardens as well as from industry.
- Most chemicals that bio-accumulate will eventually build up to toxic levels.

NOTE: Water may contain many chemicals – some are potentially dangerous to the plants and animals that live in the water and the animals that eat the plants and animals in the water. Near the base of the food chain are the primary consumers, called zooplankton. Primary consumers eat plants and are eaten by other animals.

## Method

Demonstrate how a chemical can bio-accumulate in an organism.

- 1 Read the teacher notes to the class and discuss.
- 2 Prepare for the demonstration.

Before the practical prepare:

- Jar labelled Chemical A – pour 100 ml of oil into a beaker, add some oil-based artist paint and stir until smooth.
- Jar labelled Chemical B – pour 100 ml of water into a beaker, add food colouring until it has the same colour intensity as Chemical A.

## Demonstration of bioaccumulation

Students to work in groups of four, with three small beakers and a dropper per group.

- 1 In beakers 1 and 2, put 2 cm of oil and 2 cm of water (this mixture represents the chemicals found in the bodies of 200 plankton). Create a picture to represent 200 plankton and put on the outside of each beaker.
- 2 Add two drops of Chemical A to Beaker 1 and two drops of Chemical B to Beaker 2.
- 3 Gently swirl and observe what happens. Chemical A and B are different, so the colour collects (accumulates) in different parts of our 200 plankton bodies – one in the oil and the other in the water.
- 4 Use an eye dropper to remove the water part from Beakers 1 and 2, put into the beaker labelled Waste and replace with an equal amount of fresh water (the watery waste represents the waste produced and excreted by the 200 plankton).
- 5 Repeat steps 2–3. What do you notice about the strength of the colour in each beaker? What effects might there be if these were 200 real plankton? What effect might this have on other organisms?
- 6 Repeat step 4. What do you notice about the water in the waste beaker and the colour in our 200 plankton? (Some chemicals stay in the body and some can pass through.)
- 7 Add two paper fish into all three beakers.
- 8 Reflection

What happened to the fish? Discuss results using these questions as a guide.

- What would this represent in real life?
- What could happen to anything that ate the fish? What would happen to the chemical?
- What examples of chemical pollution might there be in the lakes?
- Where might the sources of pollution in the lakes be?

## Related concepts

6g Who Eats What/Whom?

## Possible next steps

- Exploring other types of chemical pollution.
- 4e Impact of Industry: 1

# Activity 4e Impact of Industry: I (Chemical Industry)

Curriculum links

Social Studies

English

Environment Education – about

Level 3–5

4

Social Studies/  
English

## Resources required

- Copies of the chemical industry story

## Prior learning

- 4d Bioaccumulation – chemical pollution

## Teacher's notes

Key words important to this discussion are:

- **Point source discharge** – source of pollution coming from a single cause or place
- **Contaminant** – substance that makes something not pure
- **Sustainable** – capable of being continued with minimal long-term effect on the environment
- **Resource consent** – permission needed for any activity that may affect the environment

## Method

### 1 Chemical industry scenario

- Read the chemical industry story – either as a class, or in groups.
- Discuss (in groups, each with a copy of the scenario)

### 2 Questions

Focus questions

- a Is this a modern day scenario? Why/why not?
- b What impacts on the environment are occurring?

Questions to encourage more in-depth discussion, or as prompts:

- a What safety precautions are taken in the factory?
- b One of the clean-up activities involves collecting dust and sweepings.

- c Where are the dust and floor sweepings likely to be disposed of?
- d Is this the best method?
- e Are there any alternatives?
- f Some of the waste products from the factory are tipped into the drains. Where do the waste products end up?
- g Some of the machinery has special waste collection buckets.
  - i Where are these waste products disposed of?
  - ii Are there any alternatives to this?
- h What is one way that this factory uses to keep small the amount of harmful chemicals tipped into the drains (hint: near the end of the day)?
- i Why might it be a problem to tip wastes into the drain?
- j Does all waste product tipped into drains or sewers have the same effect on the environment?
- k What guidelines and regulations are in place to keep the environmental impact of industries within reasonable limits? Who is responsible for checking these?
- l What precautions are in place to protect the workers from harm?
- m What improvements could you suggest to the management? Why?
- n What precautions/regulations exist to protect:
  - i environment
  - ii workers, from possible negative effects of the industry?
- o What practices would now not be acceptable?
- p What consequences are there for industries that breach regulations?

### 3 Reflection

- Can you see any comparison with practises in your school?
- Are there any actions you might take?



# Chemical Industry Scenario

John works in a factory in Rotorua. He's been working there since he was at school. It started off as an after-school job with his uncle and now he's there full-time.

One of John's jobs is to make sure that the factory is kept clean and tidy. John has been told it's important to do so, so that the factory does quality work. No-one wants dirt and other things contaminating what they buy so part of John's job is to ensure that there is the least amount of mess around as possible. It's a safety thing too. If the factory is kept clean and mess-free people are less likely to slip or trip over things and hurt themselves or others. That last reason for keeping the factory area clean and tidy is so that the workers have pride in their environment and their work. If the factory looks better they are more likely to look after it, are more likely to have pride in their work, and are more likely to do a better job.

It was a typical day for John. He gets on well with the foreman. The foreman is making sure that John is learning about all the different operations in the factory and how to work all the machines. It's something that all the employees have to do. It means that if anyone needs help or is away that any of the workers can step in.

In the part of the factory that John is working in before lunch, they have to wear masks. This is because of the dust and the fumes – this area generates a lot. At the end of the morning the workers dust off all the machinery, wipe down all the surfaces, and put the covers back on the equipment. John sweeps the floor and puts the rubbish in the bin. He then mops the floor while the other guys start their lunch. John tips the water from the bucket down the wastewater drain. This area is only ever used in the mornings.

After lunch John heads to a new part of the factory. They are using chemicals in this area too but there are far fewer fumes so the workers don't wear masks. The machinery in this part of the factory have special waste collection buckets that the liquid waste products drip into. At the end of each day one of the jobs that needs to be done is the buckets need to be emptied. They also go down the wastewater drain.

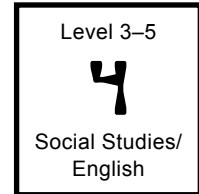
In the very last part of the day John is called quickly into another part of the factory. Someone was carrying a bottle of chemical – nothing too dangerous thankfully – and tripped over some equipment that a careless person had left in the middle of the floor. Nobody was hurt but the chemical was spilt everywhere. Seeing as it was near the end of the day anyway the foreman decided to shut the equipment down and clean up the factory early. The normal way of cleaning up this type of spill is to pour over another chemical to neutralise the first, then hose down the floor and then scrub the floor with a broom. John helped with this, then he mopped the floor as he normally does. John finished the day on time knowing that he had done a lot of hard work.

# Activity 4f Impact of Industry: 2 (Tourism)

Curriculum links

Social Studies

English



## Method

- 1 Brainstorm types of tourism around the lakes as group/class.
- 2 In groups select one tourist lake activity and research aspects of the activity using the following questions as a guide:
  - a What is the tourist activity?
  - b How many people do this activity? Who are they?
  - c What do people need to bring to the lake to do this activity?
  - d What do people take away from the lake after this activity?
  - e What possible effects does this activity have on the lake (good and bad)?
  - f What regulations or guidelines are in place to ensure that the lake is preserved and people are kept safe? What are the penalties and deterrents in place?
  - g Who monitors or controls the activity to make sure people participating are following the regulations and guidelines?
  - h What are the possible effects on the lake if these regulations and guidelines are not followed?
  - i Are there any other regulations or guidelines that could be in place but are not?
  - j What would be the effect on this activity if the lake is damaged (temporarily or permanently)?
  - k What is the best way of communicating information about looking after the lake to people involved in this activity?

Research can be a mixture of class and homework. You can use books, libraries, the internet, people, visits to the relevant area - anything that helps you find more information. You may like to contact specific people involved in the industry. Your final report is to be presented as a poster, brochure, presentation to a club, activity guide etc.

- 3 Reflection
  - Consider the differences between tourism and ecotourism?
  - Should all tourism companies have to be environmentally friendly?
  - What guidelines might you put in place?

## Possible next steps

- Visit and audit a tourism venue. Analyse the result and consider what action you might take to assist the company to reduce their environmental impact.
- Guest speakers/panel for questions and discussion
- Create a poster using summary sentences written by each group about the ways tourists use the lake e.g. (tourist activity) can affect the lake by (example). This effect is reduced by (example).

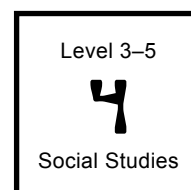
*e.g. Camping can affect the lake by untreated sewage polluting the water.  
This effect is reduced by self-composting toilets.*

# Activity 4g Impact of Industry: 3 (Agriculture and the Lakes)

## Curriculum links

## Social Studies

## Environment Education – about



## Resources required

- Starters and Strategies, Issue 66, June 2005
- Sustainable Agriculture and Water Quality – video 154 – Department of Conservation
- The Impact of Forestry on Aquatic Resources – video 155 – Department of Conservation

## Method

- 1 Brainstorm all the possible impacts farming could have on our lakes and waterways.
- 2 Waterways – downstream consequences (Starters and Strategies, Issue 66, June 2005), watch the Sustainable Agriculture and Water Quality and The Impact of Forestry on Aquatic Resources videos as well.

Introduce the following agricultural problems that can occur, if farms are not careful:

- effluent from cows and sheep can be washed from paddocks into streams and waterways
- fertilisers used on the land can be washed into waterways
- soil from crumbling banks can enter waterways

- 3 Reflection

- Can the students think of any sustainable agricultural actions that farmers could take to prevent these run-off problems occurring?

## Possible next steps

- EW FarmSim – Environment Waikato CD ROM interactive simulation of farm management choices and their effects on the environment and farm sustainability
- [www.upthecreek.org.nz](http://www.upthecreek.org.nz) – an interactive stream activity

# Activity 4h Impact of Industry: 4 (Farming)

## Curriculum links

**Social Studies**

**English**

**Environmental Education – about**

Level 3–5

**4**

Social Studies/  
English

## Resources required

- A3 sheets of paper
- Felts

## Prior learning

- Waiora – Sections 3–5
- 4g Impact of Industry: 3

## Method

The point of this activity is to:

- get students to design a farm (agricultural or pastoral) in groups
- analyse the inputs and outputs of that farm under different conditions
- what affect these have on the environment.
- they then summarise their findings.

# Design a Farm

- 1 Your task is to design a farm. You can choose whether it is a pastoral farm or a horticultural farm, or a mixture of both. You need to include the size of the farm, the shape of the farm, whether there are hills and lakes or rivers and where they are placed, and the location of any buildings on the property. Use the flow chart to help you. Draw your design onto a piece of A3 paper. You may do extra research to help you with this task.
  - a Is your farm mainly agricultural? Is your farm mainly pastoral?
  - b Is there a stream or river running through your property? Where do you get water from?
  - c Is your property flat? Where are hills placed?
  - d Where is the farmhouse on the property? Are there houses provided for workers?
  - e Do you need sheds or other storage buildings for farm equipment and supplies?
  - f What farm equipment and machinery do you need? How are they stored?
  - g What chemicals and other resources do you need? How are they stored?
  - h If your farm is pastoral, what special buildings do you require?
  - i Where are the fence lines and driveways running through your property?
  - j Where are the roads in relation to your property?
  - k What activities need to take place on your farm each day, week, month and year?

Use a range of resources or a guest panel to respond to the questions (this could be an extension activity).

- 2 Students are now required to run their farm and consider all aspects of farming. Use the following scenarios.

As part of the normal running of your farm you are going to have to deal with different situations. Your task is to describe how the different situations will affect your farm and the greater environment in which your farm is found.

# Farming Scenarios

## Situation 1

It is summer in your district so not only is it hot but the rainfall is a lot lower than expected.

- 1 How are you going to provide enough water for your animals or your crops?
- 2 If every farmer in the area does the same thing, how will that affect the water in the environment?
- 3 The season has meant that the production on your farm is reduced. One neighbour decides to buy in extra water to be delivered by tankers. Could you afford to do this?
- 4 The weather conditions mean that there is not enough food for your animals as the grass is dying off. How will you stop them starving?
- 5 If you bring out the winter feed (hay, etc) early, what will you feed them in winter?
- 6 What effect does all this have on your farm?

## Situation 2

Over the past few months the seasons and weather have been good to you. You look at the weather forecast and seeing that no heavy rain is predicted for a while you realise that now is the time to put fertiliser on your fields. You spread the fertiliser. However, the weather forecast was wrong. Instead of getting a gentle shower on one day you get a massive rainstorm that last for several days. This washes away all your fertiliser.

- 1 What happens to the water that carries the fertiliser away? Where does it end up?
- 2 What effect does this have on your farm? Do you choose to spread more fertiliser? Why or why not?
- 3 If you do spread more fertiliser, how will you afford it and how will you know it won't also be washed away?
- 4 What effect does the fertiliser have on the rivers and lakes that it eventually enters?
- 5 If you don't fertilise again (or don't fertilise at all) what effect does this have on your farm?

## Situation 3

You have had a hard financial year on the farm; however, the new year is looking brighter. You are talking to the agent about purchasing fertiliser when the agent tells you that due to several factors the cost of fertiliser has gone up a lot. You talk to other farmers and other agents and they all tell you the same thing. This was not something you could have predicted.

- 1 Do you still purchase the fertiliser? Why or why not?
- 2 Could you purchase less fertiliser but spread it more thinly? Why or why not?
- 3 What other steps could you take?
- 4 What effect does all of this have on your farm?

## Situation 4

The regional council has been talking to people who monitor the health of the lakes and rivers in your district. They are concerned about the effect that runoff from farms has on the environment. One group is particularly concerned about animal wastes. They have noted that animals go down to the rivers to drink and as a result damage riverbanks and pollute the water with their urine and faeces.

- 1 Is this a problem on your farm?
- 2 How could you stop animals from going to the river?
- 3 How could you help repair or strengthen the riverbank?
- 4 What roles does riparian management have with this problem?

Note all the input onto 'your' farm (e.g. fertiliser, stock, supplementary feed, water) from the four situations and summarise on a class chart.

<b>Inputs/outputs</b>	<b>Benefit to the farm</b>	<b>Environment impact</b>	<b>Possible alternative</b>



# Think-Pair-Share: Farming

- 1 Fertiliser helps crop growth on agricultural farms and feed growth on pastoral farms.
- 2 Fertilisers are important to all types of farms, but are more important to agricultural farms than pastoral farms.
- 3 Water is essential for farms to operate.
- 4 Farms and houses get their water from the town supply, rainwater that is collected into tanks, bores on their property, rivers and lakes on their property, or buy it in.
- 5 Fertiliser should be added just before rain is expected so the water helps the fertiliser soak into soil where it is needed.
- 6 Having water troughs in the middle of stock paddocks can help reduce animal wastes entering waterways.
- 7 Riparian management is all about choosing plants to keep the banks of rivers and lakes stable.
- 8 Fertiliser run-off and run-off from animal wastes (urine and faeces) pollute waterways.
- 9 Pollution from farm run-off changes water ways by changing the levels of oxygen and other chemicals in the water.
- 10 Run-off from farms is completely the responsibility of the farmer.

## Think-Pair-Share: farming answers

- 1 True
- 2 Don't tell this to farmers. Different roles does not necessarily mean more or less important.
- 3 True
- 4 True
- 5 False. Too much rain washes away the fertiliser. This is wasteful and pollutes the water.
- 6 True. But it is not always as simple as it sounds. Beware of expense of setting this up from scratch, logistics of keeping of the troughs full, etc.
- 7 Too simplistic. Also about choosing plants that help filter the water. Can also be about beautification and a form of "natural" fencing.
- 8 True
- 9 Too simplistic. Need to be aware of growth of aquatic plants, growth of micro-organisms, effects on other aquatic organisms (animals and plants) of this change in conditions, etc.
- 10 False. Consider rain, economics of productivity with/without fertiliser use, time taken for subsurface run-off to enter waterways (historical contamination), etc.

# Keywords Useful for Discussion

Pastoral farming	Farming animals.
Horticultural farming	Farming plants.
Stormwater	Rain. It either becomes run-off on the surface or subsurface run-off under the ground. Both types of run-off flow into waterways or storm sewers.
Land use	Exploitation of land for agricultural, industrial, residential, recreational, or other purposes.
Fertiliser	Any substance such as manure or a mixture of nitrates or phosphates used to make soil more fertile.
Nitrates	A chemical component of fertilisers.
Phosphates	A chemical component of fertilisers.
Sustainable	Capable of being continued with minimal long-term effect on the environment.
Riparian management	Riparian areas or zones are the areas of plant growth on the edge of lakes and streams. They separate the water from the land. Using the correct plants can help stabilise land and clean the water. Riparian management is how these banks are looked after.
Catchment	Land that drains into the lake or river. Any rain that falls on this land will eventually make its way into the river or lake.
Non-point source discharge	Source of pollution coming from a wide area or a hard to identify specific site.
Resource consent	Permission needed for any activity that may affect the environment.
Renewable	Something that can be used over and over again without running out.

# Activity 4i The Stormwater Problem

## Curriculum links

**Social Studies**

**English**

**Science**

**Environment Education – about**

Level 2–5

**4**

Social Studies/  
English/  
Science

## Resources required

- Stormwater colouring in chart

## Method

- 1 In pairs or small groups, students take a stormwater sheet
- 2 Identify one problem
- 3 What effect do you think this problem has? Why?
- 4 Suggest a solution – share these as a class, evaluate these options
- 5 Colour in the sheet
- 6 Reflection

Having discussed the issues:

- Could any of these problems be found in your community?
- What action might you take?

## Possible next steps

- Older students could debate options for solutions
- 4j Watery Wastes

# THE STORMWATER PROBLEM



# Activity 4j Watery Wastes

## Curriculum links

**Science**

**Social Studies**

**English**

**Environmental Education  
– about and in**

Any level

**4**

Science/  
Social Studies/  
English

## Resources required

- Tally chart or map of school

## Prior learning

- Students need to be aware of what goes down drains – learning about stormwater

## Method

- 1 Walk around the school and record using 'tally marks' or marking onto the map where there are drains, spouting, etc.
- 2 Follow up which things take the wastewater straight to the waste plant to be cleaned and filtered? How many of these are there?
- 3 Which things take the water straight to the lake? How many of these are there?
  - How do we find this out?
  - Discuss possible problems and solutions.
- 4 Reflection
  - Who do we need to tell about our findings?
  - How do we tell them, what can we do?

## Possible next steps

- Drain stencilling activities.
- 'I only drain rain' – Auckland Regional Council or Waiora

# Watery Wastes

In groups, walk around your school and record (using 'tally' marks):

- the number of things that take away the wastewater to the waste plant to be cleaned and filtered
- the number of drains that take the water straight to the lake

	Numbers found around our school
Spouting	
Toilet pipes	
Gully traps	
Drinking water	
Drain	
Ground drain	

# Activity 4K Stormwater

## Curriculum links

**Science**

**Social Studies**

**Environment Education – about**

Any level

**4**

Science/  
Social Studies

## Resources required

- Different materials such as sand, soil, grass, broken concrete or cobblestones

## Method

- 1a Stormwater Discussion
- 1b Stormwater Practical
- 2 Water movement

See over page

# Stormwater Discussion

Question students on their ideas about rain:

- Where does rain water flow to?
- Where does it flow in the grass, roofs, roads and forests?
- Is the water flow the same in fields as in forests?
- Is the water flow the same in fields and on roads?
- Extension: Where does the water go from your bath?

## Stormwater Practical

### Aim

To explore what happens when water is poured onto different surfaces such as grass, soil, sand, hard/concrete, leaves, bark-chip.

### Method

- 1 Take four buckets/empty 2 L milk containers with tops cut off and pierce small drainage holes into the bottom.
- 2 Fill with the same amount of matter (quarter/half bucket each) of your different material – sand, soil, soil and grass or plantings, cobblestone or hard paving material
- 3 Measure the same amount of water (quarter/half bucket) into each of the containers of material.
- 4 Observe and describe the behaviour of the water.
  - Does it sit on the top?
  - Does it 'move'?
- 5 Collect the water that drains from the holes in the bottom of the containers.
- 6 Measure the water as it comes out (ml) and time the flow with a stopwatch.
- 7 This will give you readings in ml/sec (mls-1) or ml/min (mlmin-1). These are good indicators about the rate of flow or how quickly the water drains through the material in the bucket.

For upper primary/intermediate and secondary classes, they can record the results in a table – i.e.:

Material					
	Soil	Grass	Sand	Concrete	Leaves/bark chip
Amount Water/ml Every 1 min					

(Younger students could record and discuss observations rather than take measurements)



8 Calculations. We can calculate the speed of draining according to the following equation:

$$\frac{\text{Amount of water/ml}}{\text{Time/Seconds}} \quad \text{e.g.} \quad \frac{100 \text{ ml}}{25 \text{ sec}} = 4 \text{ ml/second}$$

Calculate the drainage flow for the different materials:

Soil =

Sand =

Soil and grass/plantings =

Concrete=

9 Discussion

- Which material allowed the water to drain the fastest?
- Which material was the next fastest to drain the water?
- What would happen to these drain times if we 'stomped' down the material?
- To help the students understand the nature of the ground and how this affects water movement, do activity sheet 'Water movement'.

Use questions that require students to reflect on their environment and the activities happening there, and relate this to what they have learned through these activities e.g. where would be the best place to:

- Wash your car or bike?
- Put a sprinkler for playing under?

Why are some eco-towns using permeable paving materials? Why would you suggest to a Council that new footpaths could be cobblestones or pavers rather than concrete? What are the soils in this area made of?

# Water Movement

This activity helps students develop a picture of how water moves under the ground. Select five to six students to be the molecules of water, and the rest of the class will be ground material (sand, clay, gravel).

**Gravel** students stand with their arms outstretched so that they can turn around without touching anyone else.

The water molecules then move through the 'gravel'.

**Sand** students stand with their hands on their hips with their elbows bent, so that the tips touch the person next to them.

The water molecules move through the sand, experiencing some difficulty, but they should still reach the other side.

**Clay** students stand with their hands at their sides, huddled close together. They should be standing very close so that it will be difficult for the water molecules to pass through.

**Water** molecules can then gently push their way through the clay. Some water molecules may not be able to move through the clay at all.

- 1 Which ground material would be best to handle heavy downpours of rain?
- 2 Erosion can happen when there is a large heavy rainfall and the water does not drain away but washes everything away with it – even if it is a large hill! Which material might cause erosion run-off?
- 3 What are some possible solutions to preventing erosion run-off, and maintaining consistent drainage of water?

Water can collect very quickly and in large amounts, especially during a rainfall. Roofs and roads have large areas that collect the rain. Where does this rainwater go? Let's experiment:

- 1 Fill five buckets with water.
- 2 Five people take one bucket each and spread out along the netball court/asphalt/playground.
- 3 On the count of three pour the bucket of water onto the ground in a sweeping motion.
- 4 Does the water look very much?
- 5 Where did it flow to?
- 6 Where does the water flow to next?
  - All water that flows to a drain runs directly to the lake – which means NO filtering or cleaning processes.
  - All water that flows down drain pipes/spouting will eventually go to the lake.
  - What about toilet water, sink water, bath water, dish water?
- 7 Reflection
  - Relate this learning to your school environment
    - » Can you re-design your school using this knowledge?

## Related concepts

- Consider the use of wetlands as a stormwater catchment, treatment, diversion etc. Refer to Hannahs Bay resource and 'Wetlands – a vanishing ecosystem'.

## Possible next steps

- Students calculate how much water a day they use – toilet cistern, bath, washing machine, saucepan, drinks. First estimate how much water used by each student – ice-cream containers may be a good measure for home. Then collect data on toilet use, bath, drinks, boiled food and washed clothing they have in a week using a data sheet. Then produce personal graphs using Excel and collate to produce a class graph. Consider ways that they could reduce water use sensibly.
- See Waiora Section 3.

# Activity 41 Pollution – What Happens?

**Curriculum links**

**English**

**Environment Education – about**

Any level

**4**

English

## **Resources required**

- Journal of Young People's Writing Part 3, No. 1, 1988

## **Method**

- 1 Read 'Pollution – What Happens?' Journal of Young Peoples Writing, Part 3, No.1, 1988.
- 2 Create your own storyboard showing how one problem affecting our local lakes occurs.
- 3 Add a solution as an ending.
- 4 Share your endings with the class.
- 5 Vote on the most environmentally friendly ending, the most damaging etc
- 6 Reflection
  - Which were the best solutions? Why?

# Activity 4m Water Pollution - Nutrient, Bacterial, Toxic (NBT)

Curriculum links

English

Science

Level 4–5

4

English/  
Science

## Resources required

- Measuring cylinder
- Droppers
- Five 2 L drink bottles
- Soap/detergent
- Vinegar
- Flea powder
- Food scraps

## Method

Pollutants – nutrient, bacterial, toxic

- 1 Read background information.
- 2 Summarise – this can be aided by answering the following questions.
  - List the three major water pollutants. Briefly explain how they can enter the water.
  - Define ‘point source’ and ‘non-point source (NPS)’
  - Write a short paragraph on what you think could be the major pollutant in our lakes and waterways. Are these point or non-point sources?
  - Estimate how much water you use each day.
- 3 Create three headings:  
Nutrient – fertilisers, Bacterial – Human Waste, Toxic – Chemicals  
And list as many sources as possible of the three kinds.
- 4 Practical:  
Prepare examples of each pollutant by adding:
  - 2–3 ml soap or detergent to 60 ml water
  - 45 ml vinegar to 60 ml water
  - 23 ml flea powder to 60 ml water
  - 2–3 ml food scrapes to 60 ml water
  - 60 ml water – what is the purpose of this sample?

Gather five 2 L bottles (10 L) of lake water.

Make a model of the lake with pollutants. Take five 2 L drink bottles (with the tops cut off).

Fill each 'lake model' with lake water, then add one of the following pollutants to each.

Identify each as its pollution category.

- a Add the soap and water – this represents nutrient pollution.
- b Add the vinegar and water – this represents toxic pollution.
- c Add the flea powder and water – this also represents toxic pollution similar to chemicals used to kill pests on crops.
- d Add food scraps and water – this represents bacterial pollution.
- e Add water – this is the control.

Remember – all five models are alike except for the pollutants added to them.

## 5 Discussion

- After careful labelling of each, predict what will happen to each.
- Rule up a monitor sheet and observe daily, recording any differences in growth and development of algae, with possible explanations.
- After two weeks the algae and water may be safely flushed down the toilet.
- Fill in the graphics sheet.

## 6 Reflection

- Having researched and determined what Rotorua's major water pollutants are, students should list actions we can take to reduce these pollutant intakes.
- How big a take do you consider this to be?

# Background Information

## Be a responsible consumer – it makes sense

Something all of us, as individuals, can do to protect water quality and the environment is to recycle products that are not degradable. This includes glass, cans and motor oil.

Choose non-hazardous products. Most household chemical products and pesticides have warning labels. These labels tell whether the product is flammable, poisonous, corrosive or explosive. Proper disposal of these products is important to ensure water quality is not affected.

Groundwater contaminants come from two categories of sources: point sources and distributed or non-point sources. Landfills, leaking gasoline storage tanks, leaking septic tanks, and accidental spills are examples of point sources. Infiltration from farm land treated with pesticides and fertilisers is an example of a non-point source.

Sources of contamination that can cause groundwater contamination:

### Point sources

- On-site septic systems
- Leaky tanks or pipelines containing petroleum products
- Leaks or spills of industrial chemicals at manufacturing facilities
- Underground injection wells (industrial waste)
- Municipal landfills
- Livestock wastes
- Leaky sewer lines
- Chemicals used at wood preservation facilities
- Mill tailings in mining areas
- Fly ash from coal-fired power plants
- Sludge disposal areas at petroleum refineries
- Land spreading of sewage or sewage sludge
- Graveyards
- Road salt storage areas
- Wells for disposal of liquid wastes
- Runoff of salt and other chemicals from roads and highways
- Spills related to highway or railway accidents
- Coal tar at old coal gasification sites
- Asphalt production and equipment cleaning sites

## **Non-point (distributed) sources**

- Fertilisers on agricultural land
- Pesticides on agricultural land and forests
- Contaminants in rain, snow, and dry atmospheric fallout

## **Teacher's notes**

- Each person uses, on average, 480 litres per day (drinking, bathing, cleaning, toilet flushing, gardens etc). Show using a 2 L drink bottle.
- Some people are careless with our water. Farmers use chemicals to help crops grow and kill insects – which have washed into streams and lakes.
- Factories make useful products such as medicines, clothes, automobile lubricants from chemicals and water is used and wastewater discharged into streams.
- Soaps, detergents, fertilisers, sprays, human wastes, paint, oil etc have been added/discharged into our streams.
- Lakes and streams became choked with algae due to too much phosphorus (nutrient).
- Water cannot clean itself – we pollute it too much and so we must clean the water before we can use it again.



# Activity 4n Slogan

**Curriculum links**

**English**

**Environment Education – about, for**

Level 3–5



English

## Resources required

- Dictionary
- Thesaurus

## Prior learning

- What is a slogan? Find out what a slogan is and what it is used for.
- Collect a variety of effective slogans – what makes these examples effective?

## Method

### Create a statement or slogan!

1. Find meanings for the following words:

- |             |                 |              |
|-------------|-----------------|--------------|
| 1 leaching  | 5 diversion     | 9 filtration |
| 2 sediment  | 6 quality       | 10 lakes     |
| 3 modify    | 7 nutrients     | 11 wetlands  |
| 4 dispersal | 8 deterioration | 12 change    |

2. Individually make a statement or slogan with two of these words. The slogan should be able to be used to raise awareness about water quality in the lakes.

3. Reflection

- Which statements/slogans are most effective? Why?
- How can you improve the effectiveness of your statement/slogan?
- How could these statements/slogans raise awareness? Where could they be published/presented?

## Possible next steps

- Researching appropriate venues for sharing effective statements/slogans.
- Using the statements/slogans for increasing public awareness – presenting or publishing the statements/slogans at appropriate venues.

# Activity 4o Lifestyles and Personal Choices

## Curriculum links

**Social Studies**

**English**

**Environment Education – for**



## Resources required

- A3 paper
- Felt pens
- Negotiation Chart Template 3

## Method

Do this activity in stages so you don't overwhelm students and lose their focus. Rule up four columns but only give the headings and tasks one at a time. Ideas for activities may include:

- Water use (shower length, tap on while brushing teeth, leaky taps)
- Cleaning products (eco-friendly alternatives, refills)
- Transport (petrol, bikes, car efficiency, oil, car pooling)
- Food (home-made versus fast food, amount of packaging, rubbish disposal)

In pairs:

- 1 Rule your page into four columns.
- 2 The first column needs to be headed up "Household". Under this heading list all the activities that are needed to make your household work as it does (i.e. someone doing the grocery shopping).
- 3 The second column needs to be headed up "Resources". Under this heading list all the things that are required for those "Household" activities (i.e. car to get to the supermarket). Completing this column may give you ideas of other things that need to be put into the first column (i.e. to have a car you need money to run it. To have money you need income).
- 4 The third column needs to be headed up "Environment". Under this heading list the impact that using those things has on the environment (i.e. a car running badly puts lots of smoke and toxins into the atmosphere. This can harm the ozone layer and make plants, animals and people unhealthy).
- 5 The fourth column needs to be headed up "Minimise". Under this heading suggest some ways that we can try to keep the impact on the environment small (i.e. keep the car in good condition and well serviced. Use the car less by doing multiple jobs at one time).

This activity is likely to produce discussion and ideas in response to what others are saying. Take this opportunity to point out that it is still OK to use cars or get plastic bags for the shopping etc.

Get students to think about what they are doing at home and what impact this has on the greater environment, especially lakes.

Try and emphasis those things that have an impact on the lakes (i.e. litter in picnic areas while out with the family, or leaving the tap running while brushing your teeth).

Collate these ideas on one big chart.

- 6 In groups of three, each student chooses three actions from the 'Minimise' column of the big chart. Enter these on one side of the Negotion Chart template (Template 3).
- 7 From the nine actions chosen, the group negotiates the three most practical ideas for minimising environmental impact.
- 8 Each student picks one of the three most practical ideas and considers what action can be taken.
- 9 Reflection
  - Share your chosen item with a buddy. Discuss how you can make a change and what you will have to do at home to ensure it happens.
  - How can you monitor your success?

# Activity 4p Scenarios

Curriculum links

Social Studies

English

Environment Education – about



## Resources Required

- Article from the Laketown newspaper
- Group briefing cards

## Method

- 1 Introduce the activity by reading the newspaper article.
- 2 Divide the participants into five groups to represent each of the following:
  - Laketown Council
  - Laketown Residents Association
  - The Laketown Environment Group
  - The farmers group who want to convert to dairy
  - Forestry industry representatives
- 3 Ask one participant to be the chairperson (not a member of the groups). This person has the role of timekeeping and keeping order.
- 4 Give each group their briefing cards. Explain that there will be a public meeting at which all groups will have the opportunity to make their case. The first group to speak will be the farmers who want to convert their farms to dairy farms.
- 5 Each group will have 10 minutes to read and discuss their information. In this time, they are to:
  - discuss the issues and to decide what points they wish to make at the meeting (suggest that each group make a list of all aspects of the proposal that they like and those that they dislike).
  - be thinking from the perspective of the group they represent.
  - prepare a case either for or against the application. (This step may take time as extra information may be researched by students themselves.)
6. The public meeting:
  - each group must elect one representative to make their points to the Chairperson (maximum two minutes each).
  - Chairperson is to check if anyone wishes to make any further comments. The Chairperson will then summarise the important points both for and against the applications after the reflective question time.
- 7 Reflection
  - How successful was the meeting from your group's point of view?
  - What do you think were the most important points made by your group, or other groups?

- Each group is to write down the most important points in deciding whether the council should support the application for the group of farmers to convert their farms, and be prepared to report back to the whole group.
- What was the purpose of doing the activity?
- What skills did you practice and develop in the activity?
- What did you learn?

Article from Laketown Chronicle:

### **Farmers converting to dairy meet opposition!**

A group of farmers in our district have applied for consents from the Freetown Council to convert their farms to dairy operations. The council is considering their application as at present council rules govern decisions regarding land use in the area around the lakes. The possible impacts on the community, the environment and the quality of water in the lakes must be explored. To find out how the community feels about this issue, a public meeting will be held where interested groups are invited to share their views and listen to those of other interested parties. The council will be present at this meeting and will consider the views expressed during the evening.

Information about what impacts different land uses have on the water quality of streams and lakes in the catchment is available at council offices. This information comes from organisations working in the field. At this stage the council are looking positively on the applications but representative from the Laketown Environment Group is concerned. Their views will be among those presented at the meeting which will be held on Tuesday 17th August, 6.30 pm at Laketown Town Hall. Members of the public are invited to attend, but speaking time will be given only to those who book time with the chairperson in advance of the meeting.

# Briefing Cards

## Laketown Council – briefing card

You are members of Laketown Council, working on the Lake Water Quality Committee and the District Land Use Plan Committee. The council must look at all perspectives before making a decision about this application. These are the facts as you see them at this stage:

- The district plan does not specifically prohibit this type of farming, however the council does have the power to stop activities that impact negatively on the environment.
- A large body of evidence suggests that land uses that have high nitrogen production are contributing to the decline in lakes water quality.
- Water quality is one of the council's responsibilities.
- Laketown would be the first council in the country to restrict this type of proposal.

Instructions:

- You have 10 minutes to discuss this information.
- Decide what points you want to make at the meeting.
- Write them down.
- Identify one person who will talk on behalf of the group and put forward its views at the public meeting.
- You may ask questions at the meeting.
- Others may ask questions of your group.

## Laketown Residents Association – briefing card

You live in Laketown. You enjoy the environment this town offers, especially the lakes. Many people have their own boats, and many enjoy water sports. Your concerns are:

- The impact of this type of farming on the quality of the lakes environment. At present activities on the lakes are restricted due to poor water quality. You have been told that it is the farmers who are to blame, but aren't sure what that means.
- You believe people have the right to choose what to do with their land and that the council shouldn't be able to tell people what to do.

Instructions:

- You have 10 minutes to discuss this information.
- Decide what points you want to make at the meeting.
- Write them down.
- Identify one person who will talk on behalf of the group and put forward its views at the public meeting.
- You may ask questions at the meeting.
- Others may ask questions of your group.

## Laketown environment group – briefing card

You are a voluntary group who take action for the environment. You have recently been working hard on a local planting project that is aimed at restoring the native plantings around a local lake reserve, in order to improve the quality of the water in the lake, by preventing some of the run-off from the land.

Your major concern is:

- That lake water quality is so important that nothing should be allowed to happen that might make it worse.
- You know that dairy farming has a higher impact on nitrogen levels in the lake than any other land use, so are opposed to the creation of more dairy farms.

Instructions:

- You have 10 minutes to discuss this information.
- Decide what points you want to make at the meeting.
- Write them down.
- Identify one person who will talk on behalf of the group and put forward its views at the public meeting.
- You may ask questions at the meeting.
- Others may ask questions of your group.

## Forestry Association – briefing card

You are all involved in forestry around the district. You consider that forestry is “the way to go” and are disappointed to see people moving away from the industry. You consider that:

People should have free choice about the way they use the land. However, if too many people move out of the forestry industry it reduces the viability of the industry in this area by raising costs of things like transport and processing of timber.

You believe that although the forestry industry is going through a temporary decline, it will pick up if everyone sticks together.

Instructions:

- You have 10 minutes to discuss this information.
- Decide what points you want to make at the meeting.
- Write them down. Identify one person who will talk on behalf of the group and put forward its views at the public meeting.
- You may ask questions at the meeting.
- Others may ask questions of your group.

## Farmers wanting to convert to dairy – briefing card

You have put a proposal forward to council asking that you be given permission to convert your forestry land to dairy farming. Forestry is not providing the income that you need. You believe:

- Dairy farming can offer both a better income and a better lifestyle.
- You do not believe that you should even need to ask permission.
- You question the information that has been circulated that blames dairy farming for decline in water quality. You believe there are other factors involved.
- As responsible dairy farmers you would take precautions against run-off, and that good farming practices won't contribute to poor water quality.

Instructions:

- You have 10 minutes to discuss this information.
- Decide what points you want to make at the meeting.
- Write them down.
- Identify one person who will talk on behalf of the group and put forward its views at the public meeting.
- You may ask questions at the meeting.
- Others may ask questions of your group.

## Teacher's focus questions

- How does the development and practice of these skills in this activity compare with other ways of approaching a sensitive issue such as this one?
- Discuss some ways of getting students "out of role" before they leave the room.



# Activity 4q S.O.S - Save our Streams

## Curriculum links

**Science**

**Social Studies**

**Environment Education**  
– in and about

Any level

**4**

Science/  
Social Studies/  
English

## Resources required

- Scenarios 1–3 (on following page)
- Large sheet of paper
- Felt pens

## Teacher's note

- This is the same as Activity 6k Streaming Water, except this version uses drawing as the tool whereas 6k uses drama.

## Method

- 1 You will look at three scenarios for the same stream:
  - a Draw one blank stream sheet – take a large sheet of paper and draw a 'stream' running across it.
  - b Read the 'Scenario 1' card.
  - c Complete your stream sheet by drawing on the information from the 'Scenario 1' card.
  - d When complete, answer the Reflection questions.
  - e Repeat the above for Scenarios 2 and 3.

## Possible next steps

This could also be carried out as a dramatic activity – role play animals, plants and people.

## Acknowledgements

- National Waterways Project New Zealand, Lynette Brown

# Scenarios

## Scenario 1

- 1 Place trees along the riverbank.
- 2 Animals are in the stream swimming around – snails, fish (kokopu, Inanga, bullies, trout), invertebrates (mayfly, caddis fly, stonefly etc).
- 3 There are lots of aquatic plants.
- 4 This is a nice stream with fresh clean water and the animals are happy. Beautiful clear water, lots of oxygen and food.
- 5 Nearby landowners are happy as they have a nice place to live and visit, and take children for picnics etc.
- 6 It starts to rain, however the soil will not wash into the stream as the trees prevent soil erosion.

### Reflection questions

- If you were an animal, what would you like about the stream?
- What would you dislike?
- If you were the landowner what would you value about your property?

## Scenario 2

- 1 Mr/Ms Developer has just bought a large portion of the land that adjoins the stream. They have applied for and been granted resource consent to develop the land for urban housing at high density. To meet the demands for housing the developer has to chop down all trees.
- 2 Unfortunately without the shade of the lovely trees the water heats up.
- 3 As the water heats up the stonefly is no longer able to cope and dies off.
- 4 Then it rains heavily.
- 5 Now that the trees have gone the soil starts to fall into the stream building up sediment around the rocks, filling in the habitat of the mayfly and the caddis fly.

### Reflection questions

- What has changed?
- What will happen to the water quality? Why?
- What animals will be removed from the steam ecosystem?

### Scenario 3

- 1 There are no trees overhead and no food or nutrients for the stream. The food chain breaks down and the koura are left without food.
- 2 However, the developer is happy. He/she has sold most of the sections and people have started to build houses. Home owners wash their cars on their newly paved driveways and the storm water drain takes the soap suds away (to the stream). Children drop litter into the stream and the local teenagers throw their cigarette butts and beer cans into the stream.

#### Reflection questions

- What has changed?
- What will happen to the water quality? Why?
- What animals will be removed from the stream ecosystem?
- Is this now a desirable place to live?

# Background information

In October 2004 the Parliamentary Commissioner for the Environment Dr J Morgan Williams released a report called "Growing for Good".

"Growing for Good" is a powerful statement and insight into what the future may hold for us. It deals with "Intensive Farming Sustainability and New Zealand's Environment". The way we use our land and the impact this is having on the environment is the key issue at the heart of this publication.

The warnings and visions for a better future contained in Dr Morgan's report apply to all of our beautiful country. This report could be applied to many contexts in many different regions of New Zealand. However, here in the Rotorua Lakes District the consequences of ignoring the warnings in "Growing for Good" are plain to see. What we do on the land has an impact on the quality of our water systems.

Water systems are all interconnected. Ground water (water under ground), surface waters (rivers and lakes) and the seas and oceans of our planet are all connected directly. The atmosphere through evaporation and rain is the loop that brings all water together in the "Water Cycle".

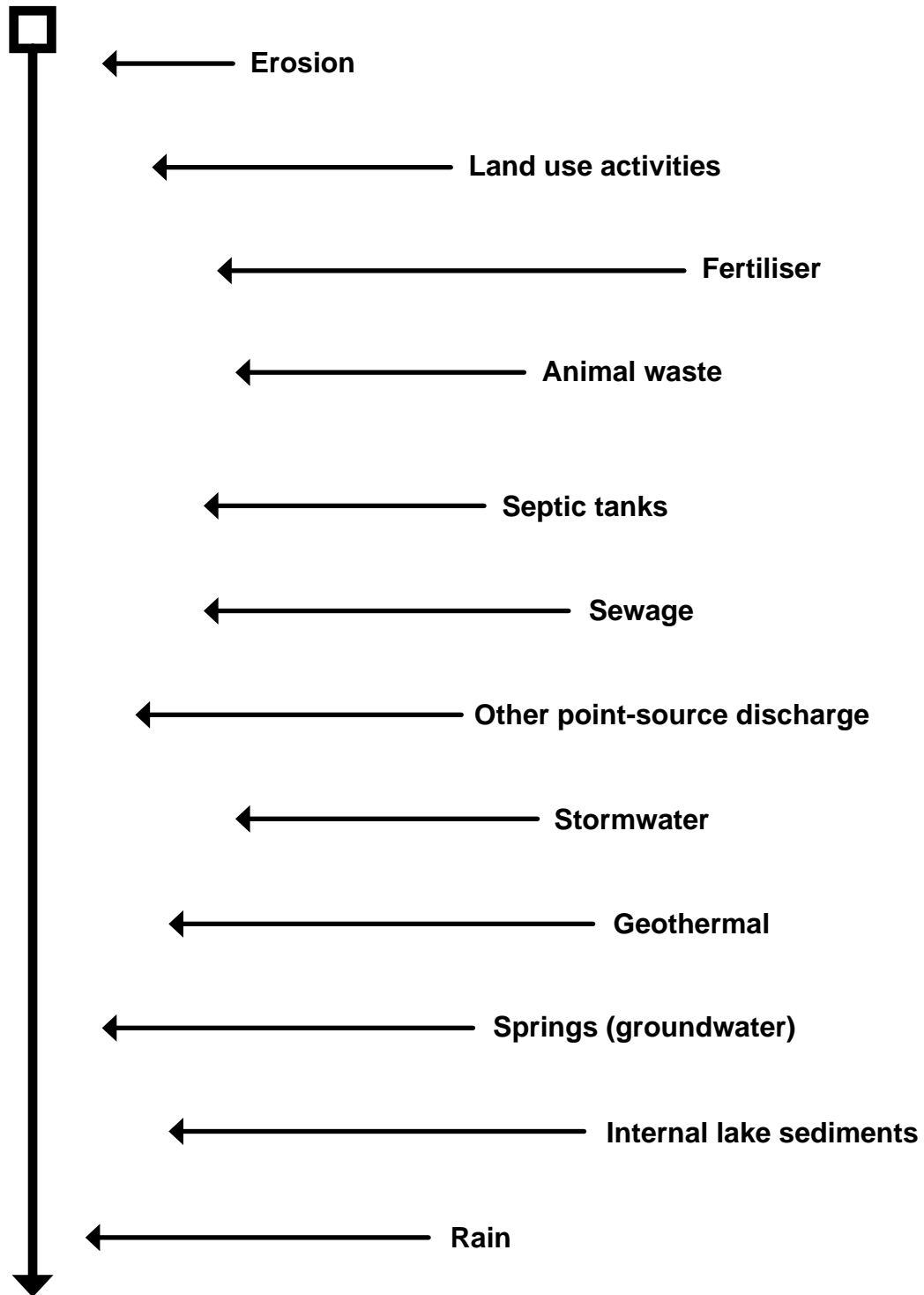
The atmospheric loop returns water to the land in a purified form. As this water "moves through the land" it acquires a signature that determines the quality of the water in its various destinations.

Recent human activity has significantly altered the "signature" of water from what it was when a natural balance was achieved through a very long time of geological change and the evolution of climax ecosystems. In the Rotorua district humans have radically altered the landscape in a very short time period. Gone is the protective mantle of the climax ecosystems, gone are the filtering wetlands fringing our lakes and rivers and gone are the small settlements of humans living as hunter gatherers. The thriving growing city of Rotorua, pasture based farming, horticulture and a network of sealed roads now dominant the region.

The new water signature that is a direct consequence of such massive changes to land use has caused a huge deterioration in the water quality of our lakes and rivers. This deterioration is now impacting not just on the natural biodiversity of our water systems but also on us. Humans need clean healthy water the same as all living organisms in a healthy self sustaining environment. This is a controversial and very important issue that must be addressed now.

# Where do nutrients in the Rotorua Lakes come from?

Catchment



Lake nutrient status