Human Impacts

This section of *Take Action for Water* introduces students to the ways in which human activities impact on the health of our catchments. Throughout this section students, as 'kaitiaki', are encouraged to consider how they might enhance the 'mauri' of the environment.

Students participate in a scenario which gives them the opportunity to apply their knowledge and understanding to solve environmental issues around catchment health and management.

10 Guardians of the mauri - Teacher notes

Linking to curriculum

Science - L3/4 Living World: Ecology

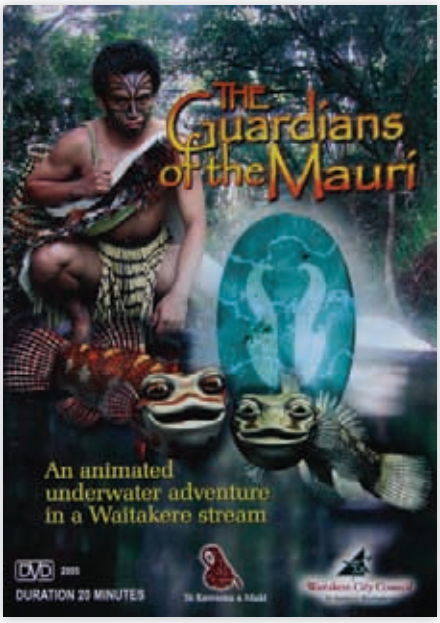
Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human induced.

Science - L3/4 Nature of Science: Participating and contributing

Use their growing science knowledge when considering issues of concern to them.

Social Studies - L 4

Understand that events have causes and effects.



Guardians of the Mauri

This DVD illustrates for students how some human activities have damaged our waterways. It follows the journey of two students who, after polluting the stream, are turned into fish and discover first hand the effects of human activities on the health of the stream. It also introduces students to a Māori perspective that, as kaitiaki or guardians, it is our role to protect the mauri of our waterways (see concepts below).

This DVD can be borrowed from the Take Action team or can be purchased from The Royal Society. Contact your Take Action facilitator for details.

Mauri and kaitiaki

The Māori concepts of mauri and kaitiaki are used throughout this resource. These concepts take a holistic view of humans and their role in the environment.

In a Māori world view all aspects of nature (eg. streams, rivers, seas, mountains, plants, animals and humans) are seen as having their own mauri, or life force. Mauri includes the energy to live, to reproduce and to fulfil one's life purpose. Mauri is in all things and therefore all things are interconnected. When the mauri is strong everything is in balance and in a state of harmony so plants, animals and humans flourish. But when mauri is weak things are out of balance and plants, animals and humans in turn become weak and sick.

Humans are kaitiaki, or guardians, of the earth and all that is on it. Their responsibility is to ensure that balance and harmony on earth is maintained. As kaitiaki humans have "user rights" to earth's resources, as do all other living things (eg. insects and fish). The abundance of Papatūānuku can not be owned, it is there to sustain all life.

10 Guardians of the mauri

Introduction

- Write the learning intentions on your board and read through with students.
- Explain to students that New Zealand / Aotearoa was a land without humans until about 1000 years ago. As more and more humans arrived in Aotearoa they made changes to its native ecosystems. Some changes have been essential for us to live, others have not.

  ? What changes have we made in our catchments that affect the streams of Aotearoa?

  Answers will vary, examples include...

  We have cut down forests to clear space for farms, towns, cities and roads; cut down forests for timber; hunted birds and fish for food; piped water from streams, rivers and lakes for drinking and irrigation; put our waste into landfills, rivers, streams and the sea.

Activity instructions

- Explain to students that, in a Māori world view, everything in the natural world has its own life force called mauri. People, animals and plants all have mauri and are interconnected. When the mauri is strong plants and animals flourish, but when the mauri is weak plants, animals and their habitats become sick.
- Some Māori believe that humans are kaitiaki (guardians) of the earth and all that is on it. While we need to look after ourselves so we can reach our potential, we also need to protect the mauri in the natural world to ensure it is in balance and harmony.
- This DVD looks at a stream in Auckland which has very similar issues to many of our Wellington streams. As you watch the DVD think about the questions on the board:

  ? Is the mauri of the stream becoming stronger or weaker? Explain your answer.

  Weaker. People have added rubbish (eg. shopping trolleys and tyres), poisoned the water and animals, installed culverts and introduced fish (eg. gambusia) that attack native fish.

  ? How could we be better kaitiaki of this stream?

  Answers will vary.

- Show DVD.

Conclusion

- After viewing the video discuss the students' answers to the questions above.
- Explain to students that this section of *Take Action for Water* looks at how human activities affect the catchment and the animals that live in it. We will investigate how the mauri of our waterways is being affected and look at what we can do as kaitiaki to look after the environment now.

Learning intentions

- Understand how humans have changed the environment (context - stream habitat and water quality)

Success criteria

Students can...

- Identify how human actions have changed stream habitats and the water quality of our streams and rivers

Resources

"Guardians of the mauri" DVD

Vocabulary

Aotearoa, balance, guardian, harmony, kaitiaki, mauri, potential

11 Deforestation - Teacher notes

Linking to curriculum

Science - L3/4 Living World: Ecology

Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human induced.

Science - L3/4 Nature of Science: Participating and contributing

Use their growing science knowledge when considering issues of concern to them.

Social Studies - L 4

Understand that events have causes and effects .

Deforestation

Deforestation is a significant problem for our streams and rivers. Originally many of our streams were forest covered, so much of the aquatic life evolved to live in cool, clean, oxygen rich water flowing over stony stream beds. The branches and leaves of trees provided shade, which kept the water cool and limited the growth of algae. Leaves and branches fell into the stream, providing food and hiding places for aquatic animals. The roots of trees and plants reduced erosion, preventing excess sediment from entering the water.

Deforestation has drastically altered our waterways. Many streams now have warm, dirty, oxygen poor water flowing over sediment or algae covered stream beds. The lack of shade causes water temperatures to increase and algae to flourish. Algae can smother the stony stream bed, destroying habitat. As it decomposes, algae uses up valuable oxygen in the stream that animals depend upon. Leaves and branches no longer enter streams, limiting food supply and reducing habitat for aquatic animals.

Without plant roots to hold stream banks together there is increased erosion and large quantities of sediment enter the water. Sediment in the water reduces visibility for animals that hunt by sight and may damage the gills of other animals. Sediment can also smother the stream bed, filling in the gaps between the stones, which destroys the habitat for many native animals.

Rata and tikanga

In the story of Rata and the Tōtara (BLM 21), Rata did not follow the correct tikanga when cutting down the tōtara. Tikanga is the correct procedure for doing something, which is based on reverence for life and awareness of the spiritual essence of all life. Tikanga ensures that resources are used sustainably and that balance in the ecosystem is maintained. There is tikanga around harvesting from the natural world, as these things have mauri and are therefore tapu (sacred) to some degree. The tapu needs to be removed and the atua's permission sought before objects (eg. trees, fish and birds) can be taken or harvested.

11 Deforestation

Introduction

- Write learning intentions on your board and share with students.
- Explain to students that early Aotearoa was a land of abundance covered by forests. When Māori arrived they soon depleted some of the natural resources (eg. moa). After this initial settling in time, they put tikanga in place to protect the natural resources. Read the story of Rata and the Tōtara (BLM 21) to learn about one aspect of tikanga.

  ? Why did the birds and insects put the tōtara back together?

  Rata didn't follow the right tikanga of asking Tānemahuta permission to have the tree and the animals were concerned that Tāne would be upset.

  ? Rata took only one tree. What would happen to the stream if he took the whole forest?

  Answers will vary.

- Humans have cleared much of the forests that once covered Aotearoa to create farms, build suburbs and cities. Most remaining forest is found in rugged mountain areas not suitable for farming.

Activity instructions

- Hand out BLM 22 and discuss the stream diagrams with students to ensure they understand them fully.
- Hand out BLM 23. Work through the completed example with students to explain how to complete the chart.
- Using the diagram, text and knowledge from previous activities, students complete the chart.

Conclusion

- On completion of the activity discuss students' answers and as a class collate ideas onto an enlarged BLM 23.

  ? How is the story of Rata relevant to us today?

  We should only take what we really need from the environment and follow correct procedures so the mauri of the forest, rivers and streams stays strong and native plants and animals can thrive.

  ? What skills, knowledge and attitude do we need to be kaitiaki?

  Answers will vary but some ideas are:

  – We need to care and want to look after our environment.

  – We need to know about the plants and animals in and around the stream and how they interact.

  – We need to know about environmental problems and what causes them.

  – We need to know how best to take action to help restore the mauri in our local area.

Report Writing

Complete the "human activity" and "kaitiaki" sections of BLM 7.

Learning intentions

- Understand how humans have changed the environment (context - deforestation of stream environments)
- Use their scientific knowledge to consider solutions for environmental problems (context - deforestation of stream environments)

Success criteria

Students can…

- Describe the effects of deforestation on a stream environment
- Identify possible solutions to deforestation that take into consideration stream ecosystems and human needs

Resources

BLM 21: Rata and the Tōtara

BLM 22: Deforestation

BLM 23: The effects of deforestation

Vocabulary

cause, deforestation, diversity, effects, erosion, sediment, tikanga

BLM 21: Rata and the Tōtara

After Tānemahuta clothed Papatūānuku with the forests, he created the birds, insects and humans. He created the forest for all the animals to use. The birds and insects ate the fruit, leaves and nectar, and used the twigs and wood to make their homes. People were also allowed to use the resources, but they had to follow the tikanga, showing respect for the forest and doing things in the correct way. Tānemahuta told the birds and insects to look after the trees because all life in the forest depended on them for survival and he would be very angry if the trees were destroyed.

Next to Tānemahuta's forest was a village. One day the widow Kura returned from gathering firewood and told her son, Rata, that she had seen a magnificent tōtara tree. Rata knew what his mother meant when she said this. He must make a waka from the tōtara and go to seek answers about his father's murder.

Early in the morning Rata went into the forest and found the tall, straight tōtara that his mother had told him about. Eager and excited, he forgot to follow the tikanga taught to him. He picked up his stone adze and started to chop at the tree. He strained and sweated as he worked. By the end of the day the tree started to topple. With one last strike of the adze it fell. Vines fell from the great tōtara as it crashed through the smaller trees and shrubs. The earth shook and then there was silence. The once proud tōtara lay on the forest floor. Rata was exhausted and as the sun was beginning to set, he decided to leave the carving of his waka until the next day. He walked home slowly, satisfied with his work.

As soon as Rata left, the forest became alive with sound. The birds and insects rushed out to see the damage, worried about Tānemahuta's reaction to the felling of the great tōtara. They decided to put the tree back together. Several hours later the tree stood tall once more, with every wood chip and splinter back in place.

In the morning Rata came back and was astonished to see the tree standing tall. Had he dreamed about cutting down the tree? Feeling confused and angry he began to chop once more. By the end of the day he had felled the tree, cut off its limbs and started to hollow out his waka. When it became too dark to work he returned home exhausted. Once again the birds and insects emerged from the forest and put the tree back together.

As the sun rose, Rata returned to the forest to complete his waka. Once more, Rata found the mighty tōtara standing before him. Once more, he was angry and once more he set to work. By late afternoon the tree lay on the forest floor. Rata pretended that he was finished working for the day, but instead of going home he hid in the undergrowth where he waited and watched to see what would happen next. Soon the insects and birds emerged and started to put the tree together again. Rata was furious, he jumped out from his hiding place and grabbed Pīwaiwaka (fantail) and demanded an explanation.

Pīwaiwaka explained that Rata, in his haste, had forgotten to follow the tikanga required by Tānemahuta. He had not asked for permission to cut down the tree. Rata was instantly shamed, he knew he was wrong and was sorry. Suddenly the trees shook and quivered, and then there was silence. It was a sign from Tānemahuta that Rata now had permission to use the tree. Rata gave thanks to Tānemahuta. The birds and insects told Rata to go home, they would finish the waka. This time when Rata returned in the morning he found a beautifully carved waka. He gave thanks to Tānemahuta again and set off on his quest.

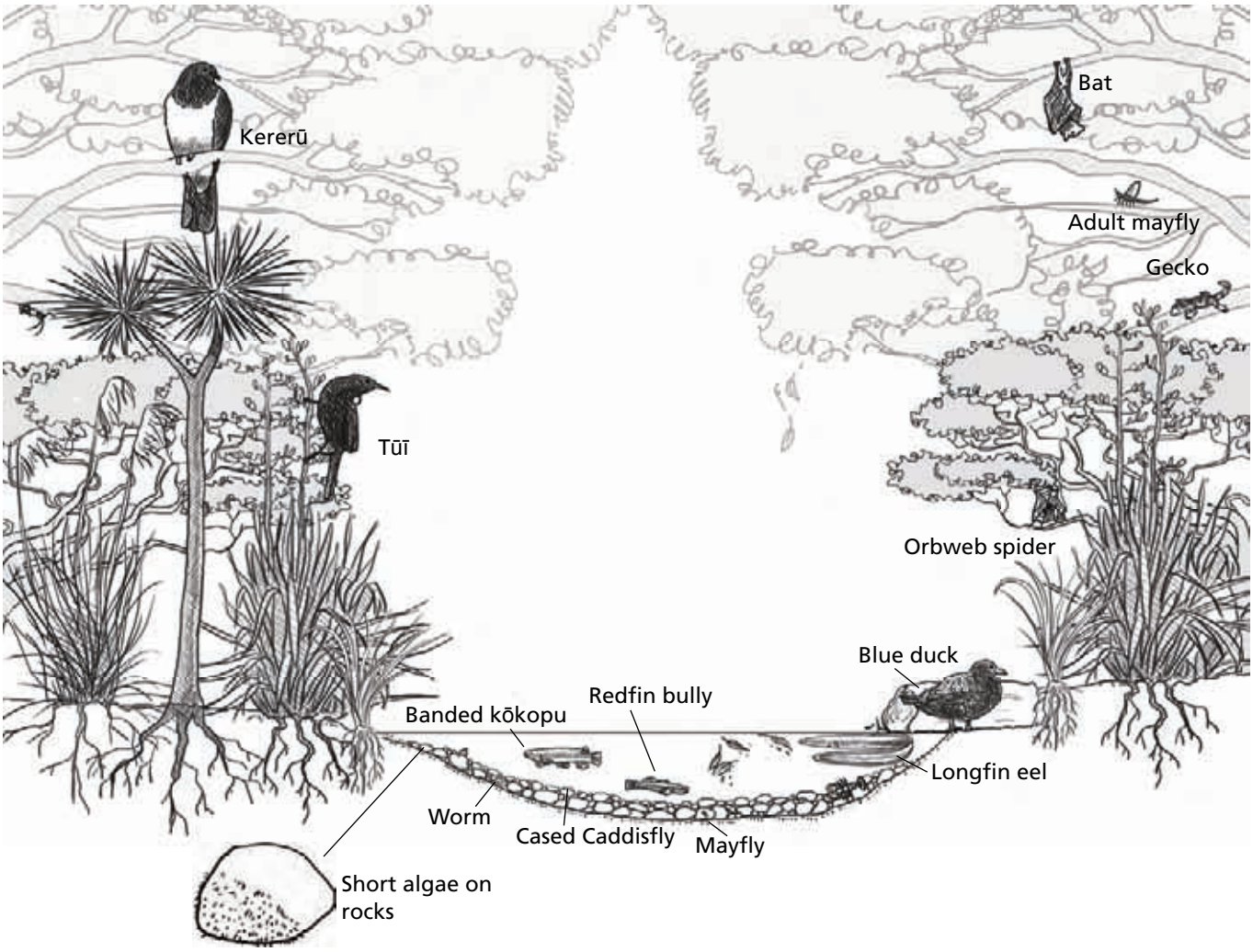
Tiakina ngā manu, ka ora te ngahere. Ka ora te ngahere, ka ora ngā manu.

Look after the birds and the forest flourishes. If the forest flourishes, the birds flourish.

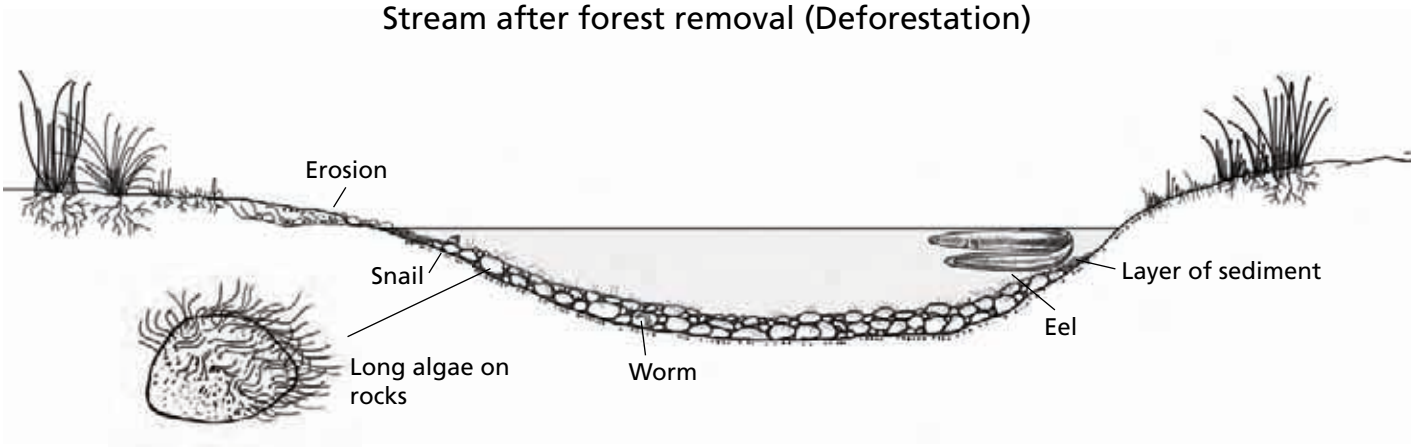
BLM 22: Deforestation

The diagrams below show a stream before and after forest removal (deforestation). The trees in the bottom diagram have been cut down to make way for a farm.

Forest covered stream



Stream after forest removal (Deforestation)



Complete the chart on BLM 23 to show the effects of removing the trees on the stream and the animals in the stream. Use the diagrams above and your knowledge from previous activities to help you. The first section has been completed for you.

11 Deforestation - Teacher notes

Answers to BLM 23

1. More algae growing on the rocks.

   Algae smothering the stream bed reduces habitat for mayflies, caddisflies and banded kōkopu.

   Decaying algae in the stream uses up the oxygen that mayflies and caddisflies depend on.

2. Banks erode more easily causing more sediment to enter the stream.

   Sediment in the water reduces the clarity, which may affect animals that rely on sight for hunting (eg. redfin bully and blue duck).

   Sediment may damage the gills of mayflies.

   Sediment covered algae is not eaten by mayflies.

   Sediment smothering the stones destroys habitat for mayflies, caddisflies and banded kōkopu.

3. There is less food for banded kōkopu who eat insects and spiders that fall into the water from the surrounding forest.

4. There is less food for caddisflies, who eat leaves that fall into the water from trees.

5. There is less habitat for aquatic animals, as branches from trees no longer fall into the stream.

6. Animals that need cool, clean, oxygen rich water die off or move to a better part of the stream.

   Animals that live under stones die off or move to a better part of the stream.

   Animals that feed on insects that need cool, clear, water don't have food (eg. blue duck).

   Only animals that are tolerant of sediment covered stream beds survive (eg. worms, snails and eels).

7. The mauri is weakened as animals are dying and/or leaving this part of the stream.

8. As kaitiaki we can fence off the stream from animals and plant native trees along the edge of stream.

   We will also need to provide water for stock as they can no longer drink from the stream.

BLM 23: The effects of deforestation

Features of forest covered streams	How does deforestation affect the stream and the aquatic animals?
Stream cover The stream is shaded by the trees so the water is kept cool and contains lots of oxygen.	Water temperature increases as there is no shade. Warm water reduces the amount of oxygen. Some animals can't survive in warm water. Mayflies can't live here as they need lots of oxygen.
Algae The trees reduce the amount of sunlight reaching the stream so algae only grows in a thin layer on the rocks.	1.
Erosion The stream banks are held together by the roots of plants and trees so there is very little sediment in the water. The stream bed is stony with gaps between rocks.	2.
Food for banded kōkopu Insects and spiders living on the trees sometimes fall into the water and provide food for the banded kōkopu and other fish.	3.
Food for cased caddisfly larvae Leaves from the trees fall into the stream and provide food for caddisflies and other aquatic insects.	4.
Habitat for fish and small aquatic animals Branches from the trees fall into the stream and provide cover (habitat) for fish and small aquatic animals.	5.
Diversity of animals There are lots of different types of animals living in the stream.	6.

Mauri What overall affect does **deforestation** have on the mauri (life force) of the stream?	7.
Kaitiaki How can farmers use the land for farming (to make a living) and still respect the natural environment so that the **mauri** of the stream is protected?	8.

12 Stormwater drains - Teacher notes

Linking to curriculum

Science - L3/L4 Nature of Science: Participating and contributing

Use their growing science knowledge when considering issues of concern to them.

Social studies - L4

Understand that events have causes and effects.

Stormwater pollution

Students need to have a sound understanding of the stormwater system as this system is often implicated in polluting our waterways. Stormwater pollution will be investigated in Activity 13.

Stormwater, wastewater and drinking water

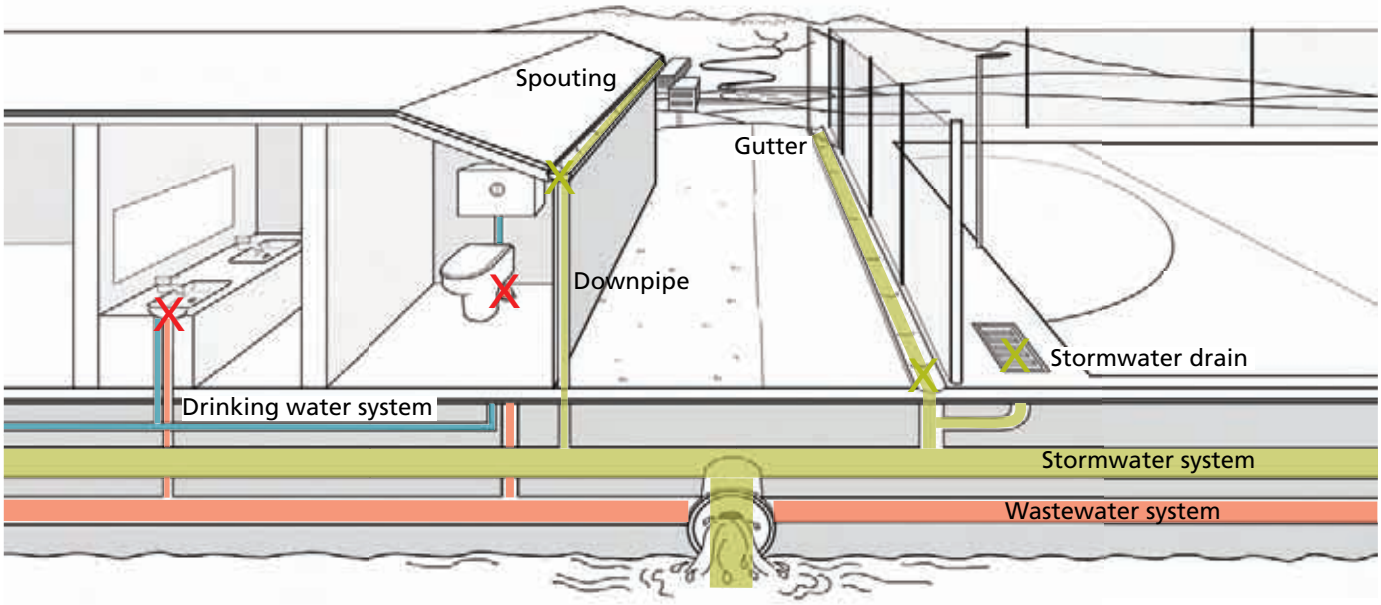
Stormwater systems are designed to prevent flooding in urban areas by channelling rain water into drains, which then travels through underground pipes and into the nearest waterway (eg. local stream, river or sea). This water is not treated or cleaned in any way.

Stormwater (rain) is collected from roofs of houses and buildings and is directed along the spouting and down the downpipe before entering the stormwater drain. Stormwater from paved areas of ground (eg. footpaths, roads and netball courts) is directed along gutters before entering a stormwater drain and travelling through underground pipes and into the nearest waterway.

The wastewater system is designed to remove sewage (from the toilet) and wastewater (from hand basins, kitchen sinks, showers and washing machines) from buildings. The water is treated to remove most harmful bacteria, solids and other pollutants. These can be disposed of on land, and treated water can be discharged into rivers or out to sea.

The drinking water system is designed to bring clean drinking water into our buildings. Our water is supplied in three stages. First the water is collected from a natural source (eg. river, lake or aquifer). It may then be treated and cleaned so it is safe to drink. Finally it is distributed to our homes, schools and workplaces.

Answers to BLM 24



12 Stormwater drains

Introduction

- Write the learning intention on your board and discuss with students.

? In 'talking partners', students discuss how we use water in our everyday lives.

Select a small number of partners to share their ideas with the class.

Activity instructions

- Hand out BLM 24 to the students and explain that there are three different types of pipes that take water to and from our schools, homes and workplaces. Read the descriptions of the stormwater, wastewater and drinking water systems to the students.
- Looking at the diagram, students work out which system the different pipes belong to. They then colour the pipes of the different systems in different colours (stormwater - green, wastewater - red, drinking water - blue).
- Students then label where water enters the stormwater system with a green X and where water enters the wastewater system with a red X, before naming the different parts of the stormwater system.
- On completion of the activity discuss the answers to the BLM.

? Where does stormwater go? Is it treated?

Stormwater travels through underground pipes and flows into the nearest waterway (local stream, river or sea). It is not treated.

? Where does wastewater go? Is it treated?

Wastewater goes through pipes to a treatment plant, where things that are harmful are removed. The treated solids are disposed of on land, and treated water can be discharged into rivers or out to sea. Some houses may have septic tanks to collect their wastewater. Solids are pumped out and liquid wastes are drained into an area around the tank.

- Take the students outside to locate the features of the stormwater system in your school grounds (eg. down pipes, gutters and stormwater drains on concrete areas). This activity can be extended by students locating and recording these features on a school map.
- If possible show the students where the stormwater drains discharge into the local stream, river or sea.

Conclusion

- Back in class recap on the stormwater and wastewater systems.

? Could our stormwater system have negative effects on the local stream, river or sea?

Record student ideas on a class chart.

Stormwater carries pollutants (such as oil, petrol, rubber from roads) from the land into the waterways.

Learning intentions

- Understand the difference between stormwater, wastewater and drinking water systems (context - a catchment)

Success criteria

Students can…

- Identify the difference between stormwater pipes, wastewater pipes and drinking water pipes

Resources

BLM 24: Stormwater, wastewater and drinking water

Vocabulary

discharge, downpipe, drinking water, drains, gutter, septic tank, treated, treatment plant, sewage, stormwater, wastewater

BLM 24: Stormwater, wastewater and drinking water

The **stormwater system** prevents flooding. The rain water is drained from hard surfaces such as concrete and then travels through underground pipes to the nearest waterways (the local stream, river or sea).

The **wastewater system** removes sewage and wastewater from buildings through underground pipes. The water is treated to remove things that would be harmful, before being disposed of (on land or in rivers or the sea).

The **water supply system** brings clean water that has been collected and treated to our buildings through underground pipes.

Look at the picture:

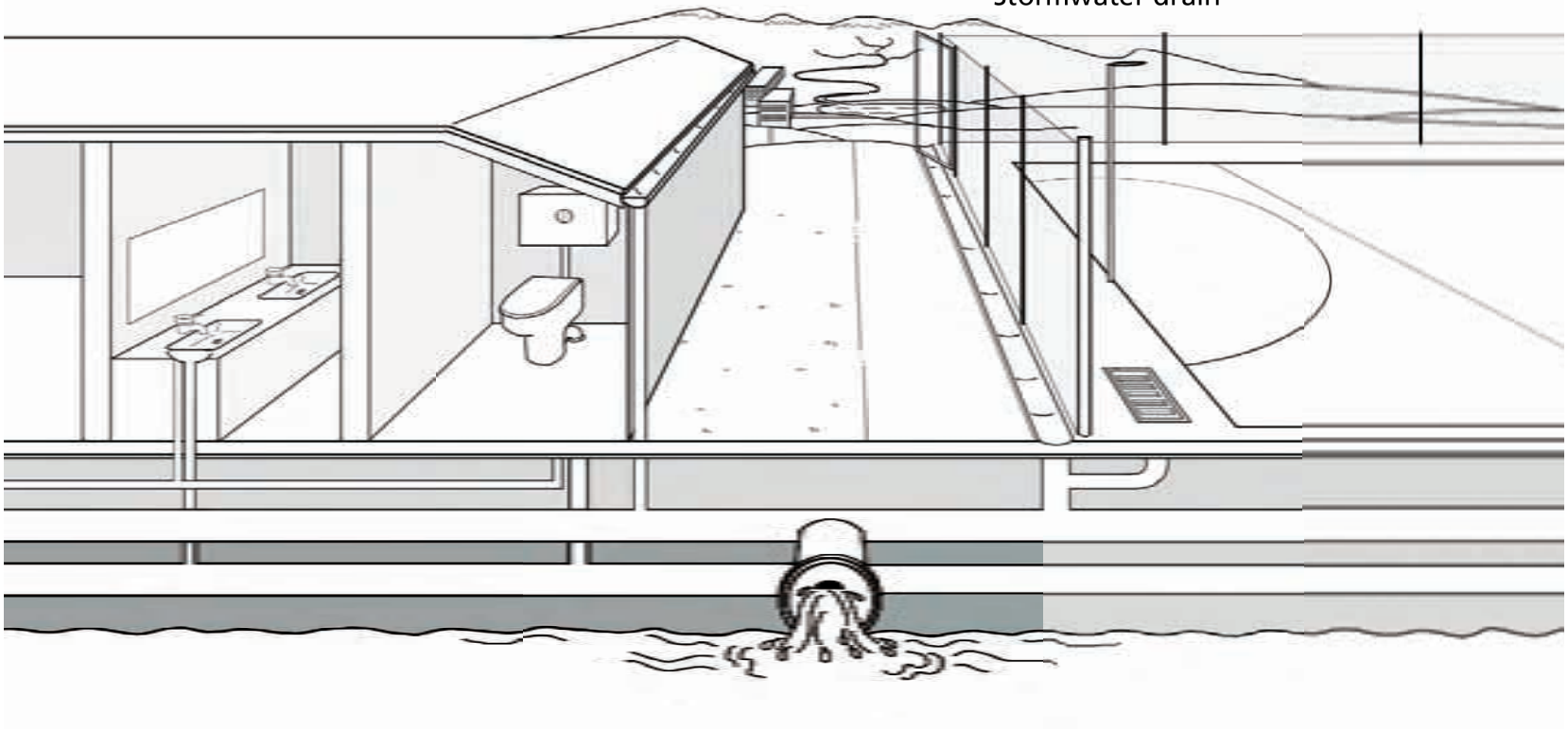
1. Colour the stormwater system green, the wastewater system red and the water supply system blue.
2. Mark with a green X where water enters the stormwater system and a red X where water enters the wastewater system.
3. Locate and name the following parts of the stormwater system:

   Spouting

   Downpipe

   Gutter

   Stormwater drain



13 Pollution - Teacher notes

Linking to curriculum

Science - L3/4 Living World: Ecology

Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human induced.

Science - L3/L4 Nature of Science: Participating and contributing

Use their growing science knowledge when considering issues of concern to them.

Social studies - L4

Understand that events have causes and effects.

Pollution

Pollution is a major problem for our waterways as it reduces the quality of the water, destroys habitats and kills plants and animals. In urban areas most pollution problems are related to stormwater drains and earthworks. Stormwater washes whatever is on the roads and footpaths directly into our stormwater drains and into our streams.

There are many different kinds of pollutants that find their way into our stormwater system. Below are some examples of such pollutants:

Vehicle pollutants	oil, petrol, zinc from brake linings and rubber from car tyres.
Chemical spills	by industry as well as from private homes (eg. paints).
Green waste	people sweeping garden refuse, autumn leaves, lawn clippings and dirt into gutters.
Paint and zinc	from degrading roofs.
Concrete	during construction and erosion of concrete surfaces.
Herbicides and pesticides	weed killers and treatment for insect pests.

Poor site management at earthwork sites (eg. where new houses or buildings are being built) causes sediment to enter waterways. In rural areas animal waste, fertilisers and agrochemicals are the main pollutants.

13 Pollution

Introduction

- Write learning intentions on your board and share with students.
- Write the words below on the board and as a class discuss their possible meanings. Compare students' ideas with the dictionary definitions below.

Pollute	"to make unfit for or harmful to living things"
Pollutant	"something that pollutes"
Pollution	"the introduction of harmful substances or products into the environment"

Activity instructions

- Explain to the class that they will now investigate pollutants that can be discharged into our streams and rivers.

  ? In 'talking partners' discuss the following statement:

  Is there such a thing as stormwater pollution? Yes or No? Explain.

  Yes. Rain washes any pollutants on hard surfaces (eg. roads, roofs) down into the stormdrain and into the closest waterway.

  ? What kinds of pollution enters streams directly?

  Answers will vary.

- Divide the class into six groups and hand out BLM 25 and a photocard to each group. Work through the questions on the BLM so the students understand their task. Explain that they must use the card and their knowledge from the previous activities to answer the questions.

Conclusion

- On completion of the activity ask each group to share their photocard with the class and discuss their answers.
- Photocards and BLMs can then be displayed.

Report Writing

Complete the "human activity" and "kaitiaki" sections of BLM 7.

Learning intentions

- Identify causes and effects of pollution (context - streams)
- Use their growing scientific knowledge to consider solutions for pollution incidents (context - streams)

Success criteria

Students can…

- Discuss the causes and effects of pollutants in streams
- Identify possible solutions to pollution that will protect stream habitats

Resources

Pollution photo cards x6

BLM 25: Stream pollution

Vocabulary

concrete, earthworks, fertiliser, leachate, oil, paint, petrol, pollutant, pollute, pollution, sediment, tyres

13 Pollution - Teacher notes

A Answers to BLM 25

Animal waste

1. B, C, E, F
2. Cow waste discolours the stream and the ammonia it contains kills fish and aquatic insects.

   Waste can cover the stream bed which increases numbers of snails and worms but reduces numbers of stoneflies, mayflies, cased caddisflies and fish that live between the rocks.

   Nutrients from this natural fertiliser encourage excess algae and weeds to grow. Too much algae fills up gaps around rocks where mayfly and caddisfly larvae live. At night and as it is dying, algae uses up valuable oxygen in the water, so mayflies and stoneflies are unable to live there.
3. We can fence off streams so cows don't have direct access to the stream.

Concrete

1. B, C
2. Lime in concrete burns and kills animals (eg. 282 eels were killed in a stream in Auckland when concrete was washed into it).
3. We can divert concrete and wastewater away from stormdrains and streams, to an area where it can soak into the ground. We should also sweep up all leftover concrete. If it looks like it's going to rain, no concrete work should be done as it may be washed into stormdrains and waterways.

Leachate

1. B, C
2. Leachate is produced when rainwater passes through waste in a landfill. It can filter out under the landfill to groundwater and streams unless it is contained. When leachate picks up soluble chemicals it can become toxic and can harm and sometimes kill fish and invertebrates.
3. We can reduce the amount of waste we send to landfills to minimise leachate produced. Organic waste is particularly prone to producing leachate so composting or worm farming our food scraps will help reduce the amount of leachate in streams and groundwater.

Oil and petrol

1. C, D
2. Oil can cover the surface of the water, preventing oxygen from entering the water. It also smothers birds and other animals that come into contact with it. Petrol can damage gills, poison animals and burn plants.
3. We need to look after our vehicles and fix any leaks. When draining oil from a vehicle, collect it in a container and recycle it. If everyone used their cars less there would be less petrol and oil on our roads.

Paint

1. A, C,
2. Paint changes the colour of the stream and blocks light entering the stream. This kills algae and animals that feed on it. Paint is poisonous to all animals in and on the edge of the water.
3. We must be careful with washing paint brushes and disposing of paints. Unwanted or left over paint can be recycled but should never go near the stormwater system (eg. down the outside drains). Paint brushes that have used water-based paints can be safely cleaned in the laundry tub or outside in the wastewater gully trap. Brushes that have used oil based paint and the solvents that are used for cleaning these brushes must not go down the wastewater or stormwater systems. You can re-use the oil brush cleaners (eg. turpentine) by allowing the paint particles to settle and then pour off the clear liquid to reuse later.

Sediment

1. A, B, E
2. Sediment will turn the stream brown. As sediment covers the stream bed the numbers of snails and worms will increase but animals that live between the rocks (eg. stoneflies, mayflies, caddisflies and fish) will disappear.
3. When we disturb the soil we must ensure that we prevent sediment entering the stream and stormwater drains. Earthwork contractors do this by making a range of sediment traps that keep soil out of the water.

BLM 25: Stream pollution

Cause of pollution

What is the **pollutant** illustrated on your photocard? How does it enter the stream?

1. The effect of pollution

Colour in the boxes to show the negative effects that your pollutant has on the stream habitat.

A. It **blocks light** from entering the water which may kill algae. Animals that eat algae won't have any food.

B. It makes the **water dirty and cloudy**. Dirt in the water may damage animals' gills and make it hard for some animals to breathe and see.

C. It **poisons** the water and the animals that live in the stream.

D. It floats on the water and **stops oxygen** from getting into the water.

E. It **smothers algae** which some animals need to eat. It may also **fill in the gaps** between the stones on the stream bed where animals live.

F. The extra **natural fertiliser** helps long algae and weeds to grow in the stream. As this algae dies it uses up valuable oxygen in the water.

2. Mauri

What effect does **this pollution** have on the **mauri** of the stream and the life within it?
(Explain how some animals that you have already learnt about will be affected)

3. Kaitiaki

How can people protect the **mauri** of the stream and prevent **this pollution**?

14 Stream habitat destruction - Teacher notes

Linking to curriculum

Science - L3/4 Living World: Ecology

Explain how living things are suited to their particular habitat and how they respond to environmental changes, both natural and human induced.

Science - L3/L4 Nature of Science: Participating and contributing

Use their growing science knowledge when considering issues of concern to them.

Social studies - L4

Understand that events have causes and effects.

Stream habitat destruction

We have altered the habitat of aquatic animals in many streams and rivers in our region to meet our needs. We pipe streams underground so we have more flat land available for building and to reduce the possibility of flooding. We straighten streams so rain water can be removed from urban areas as quickly and efficiently as possible. We install culverts to enable cars and stock to safely cross streams. We take water for people to drink and wash. We take water to water plants and give to animals that provide us with food. All of these activities have an impact our native aquatic ecosystems.

While we may need the things mentioned above, we still need to consider the impacts that we have on our natural environment. This activity challenges students to think how we can meet our needs while also looking after the environment.

Longfin

This DVD illustrates the life of a longfin eel and the journey it takes to migrate and complete its lifecycle. It clearly shows how eels have to cope with many human pressures (eg. dams).

This DVD can be borrowed from the Take Action team or can be purchased from Longfin Films. Contact your Take Action facilitator for details.

Answers to BLM 26

We have included some possible answers below, but students may come up with many other ideas.

Taking water from the stream and groundwater

1. If water levels drop too much the water temperature can increase causing stress for animals. If too much water is taken and the stream dries up animals will have nowhere to live and may die.
2. We need to only take the water we need and use it wisely. We can do this by watering only the roots of plants, turning taps off when not in use, installing water tanks to collect rain water, having shorter showers and fixing leaks.

Expanding our landfills

1. As parts of the stream are sometimes filled in to make landfills the amount of habitat available for animals is reduced. Leachate sometimes leaks from landfills and can poison the water downstream, which may change the colour of the water and harm or kill some animals.
2. We can reduce, reuse and recycle more. This will reduce the rate that we need to extend our existing landfills and therefore we will protect our streams.

Straightening streams for drainage

1. Straightened streams have no riffles and so there are no oxygen rich habitats for mayflies, stoneflies and caddisflies to live. In floods there are no deep, slow water areas (pools) for animals to find safety, so much life will be washed away.
2. We can make people more aware of our streams, the life in them, and what they need to flourish. People can advocate for streams to be preserved and restored so they can support life.

Building culverts to cross streams

1. Many fish cannot get past a poorly installed culvert to reach the upper reaches of the stream. While many native fish can climb rocks in the water they can not 'jump' up to a hanging culvert.
2. We can make special fish passes (these rocky ramps help the fish get up to and through a culvert). We can ensure that all future culverts are installed properly, so the fish can swim through them. We can educate people about the needs of our native fish.

14 Stream habitat destruction

Introduction

- Write learning intentions on your board and share with students.

? In 'talking partners', students share ideas about how humans might currently damage stream habitat.

Select a small number of partners to share their ideas with the class.

Activity instructions

- Working in groups of three, students will investigate one issue illustrating how humans have changed streams. They will then complete this section of BLM 26.

  Ensure that there is an even spread of students over the four different issues to be covered (eg. a couple of small groups looking at each issue).

- As a class share the four different issues of humans changing streams. Expert groups report their learning and ideas back to the rest of the class and these can be discussed.
- Collate ideas and learning on an enlarged copy of BLM 26.
- Show the DVD Longfin. This DVD shows the life of a longfin eel and how it is affected by human activities. Write the following questions on the board for the students to consider while watching the DVD.

? How has human activity affected the longfin eel?

We catch eels for food and to send overseas. As eels only breed once, these eels never get the opportunity to reproduce. Dams block eel migrations to and from the sea, therefore some eels can't get to sea to reproduce while others are unable to move up the catchment to grow and develop.

? How do some people help longfin eels?

They catch them and transport them to the other side of hydro electric dams so they can complete their migration.

? How could we be better kaitiaki for the longfin eels?

Answers will vary. For example, protect their habitats.

Conclusion

? Have you seen any of these examples of stream habitat destruction in our community?

If there are examples of these in walking distance of school you could arrange a class outing to view them.

Report Writing

Complete the "human activity" and "kaitiaki" sections of BLM 7. The students have now completed their note taking and can draft their report on BLM 8.

Learning intentions

Students will…

- Understand how humans have changed the environment (context - stream habitat destruction)
- Use their growing scientific knowledge to consider solutions for human impacts on the environment (context - stream habitat destruction)

Success criteria

Students can…

- Describe the effects of water irrigation, stream straightening, extending landfills and building culverts on stream environments
- Identify solutions to habitat destruction that takes into consideration stream habitats and the needs of humans

Resources

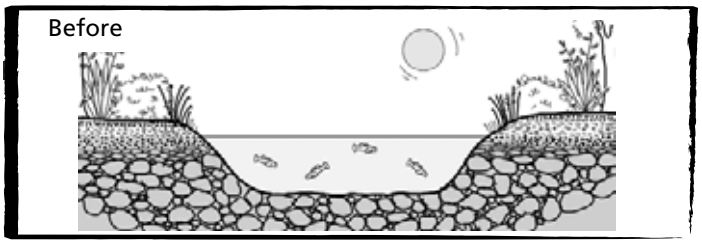
BLM 26: Changing the stream

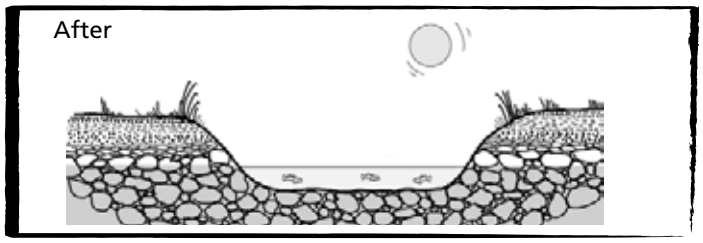
"Longfin" DVD

Vocabulary

culvert, drought, efficiently, expanding, extract, flow, irrigate, leachate, moist, poison, waste

BLM 26: Changing the stream – taking water





Why do we take water from streams and groundwater?

- Water is piped into our homes for drinking, washing and flushing toilets.
- Water is used to keep farmland and crops moist so that grass and plants will grow.

Effects on streams

- Taking water can lower groundwater and stream levels, especially during a drought.

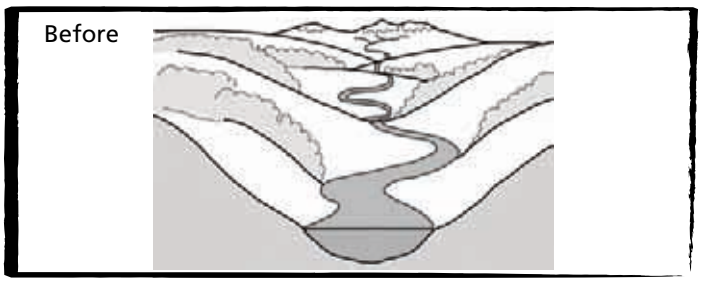
1. Mauri

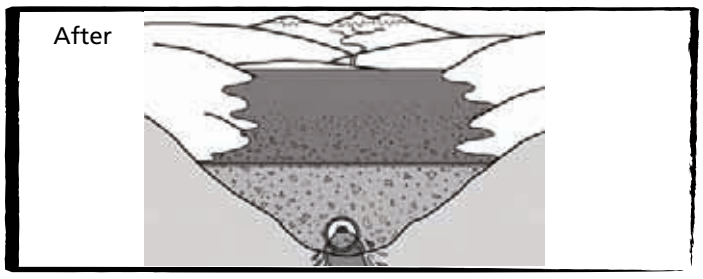
What effect does **taking water** have on the **mauri** of the stream and the life within it?

2. Kaitiaki

How can we **take water** to meet our needs and still protect the **mauri** of the stream? What are the possible solutions?

BLM 26: Changing the stream – expanding our landfills





Why do we make landfills?

- We create a lot of waste every year and it has to go somewhere!
- Landfills (in valleys) are expanded to bury the growing amount of waste we create.

Effects on streams

- The stream is piped under the landfill.
- Leachate, which can be poisonous, can enter streams from landfills.

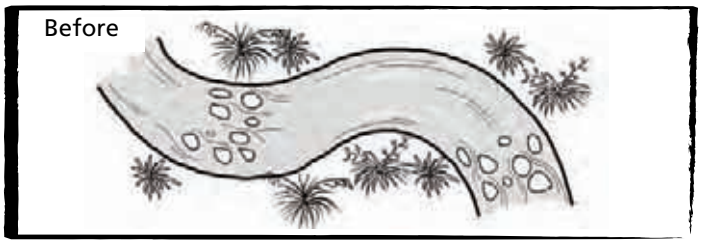
1. Mauri

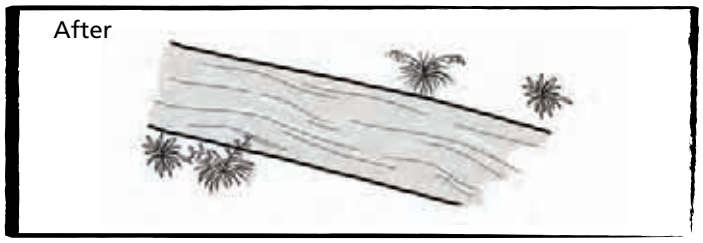
What effect does **expanding landfills** have on the **mauri** of the stream and the life within it?

2. Kaitiaki

How can we better take care of our **waste** to help protect the **mauri** of the stream?

BLM 26: Changing the stream – straightening streams





Why do we straighten streams?

- Streams do not always flow where we want them (eg. housing and urban areas).
- Streams are often straightened or piped so they can drain rain from housing areas and farms more efficiently.

Effects on streams

- A straightened stream is a long run with no pools or riffles.

1. Mauri

What effect does **straightening streams** have on the **mauri** of the stream and the life within it?

2. Kaitiaki

How can we better take care of streams that have been **straightened** to help restore the **mauri**?

BLM 26: Changing the stream – building culverts

Why do we build culverts?

- Culverts are pipes placed in rivers and streams to allow people and stock to more easily cross the stream.

Effects on streams

- Poorly installed culverts and pipes hang high above the streambed.

1. Mauri

What effect do **poorly installed culverts** have on the **mauri** of the stream?

2. Kaitiaki

What can we do about **poorly installed culverts** that will help to restore the **mauri** of the stream and the life within it?

15 Clearwater catchment scenario - Teacher notes

Linking to curriculum

Science - L3/4 Nature of Science: Participating and contributing

Use their growing science knowledge when considering issues of concern to them.

Explore various aspects of an issue and make decisions about possible actions.

Social Studies - L 3

Understand how people view and use places differently.

Social Studies - L 4

Understand that events have causes and effects.

The Arts: Drama - L 3 Developing practical knowledge.

Use techniques and relevant technologies to explore drama elements and conventions.

NB: This activity will be completed over three sessions.

Scenario

As the last series of learning activities in this section of the programme, the Clearwater Catchment Scenario attempts to utilise student learning and understanding to consider the issues around catchment management. It leads students into thinking about how human impacts affect the catchment and what actions can be taken to minimise these impacts. This will lead on to students examining how they will take environmental action for their own catchment in the 'Take Action' section of the programme.

The Clearwater catchment

Clearwater is a fictitious catchment which is used to demonstrate how a number of human impacts may influence waterways. There are many other issues in a catchment and these are just an example of what may occur. Students should be encouraged to examine the human issues around decisions that residents make and to consider the economic, social and environmental facets of a sustainable catchment.

Hotseating

Hotseating is a drama tool which enables class members to question or interview someone who is in role (eg. as a character), to bring out additional information, ideas and attitudes about the role.

15a Clearwater catchment scenario

Introduction

- Write learning intentions on your board and read through these with students.
- Display Poster 4 and while students are viewing the poster, share the story of Clearwater and its catchment (BLM 27).

Activity instructions

- Explain to students that they are going to take on the role of one of the residents in the Clearwater catchment to enable them to better understand how they contribute to the issues surrounding the health of the catchment.

  ? How do you 'take on' a role?

  You need to 'think' like that person would think. This is not you thinking – it's the farmer or the developer or the business woman etc.

  You need to consider what the issues are for them

  – What are their needs?

  – What are they trying to achieve?

  – What are their priorities?

- Divide the class into eight even groups. Each group receives a different role card from BLM 28. Groups read and discuss the information on their role cards. Students will take on this role over the next few sessions.
- Issue a copy of BLM 29 to each group. In groups the students complete the BLM, discussing how their actions are impacting on the catchment, why they are acting in this way and how these actions affect the mauri of the catchment.

Conclusion

- On completion of BLM 29, groups share their ideas with the class. As groups are feeding back their ideas you can collate and record class ideas on chart paper.

Learning intentions

Students will…

- Investigate how people view and use places differently (context - residents of a catchment)
- Explore the causes and effects of human actions (context - catchment scenario)

Success criteria

Students can…

- Explain how the residents of Clearwater catchment use the catchment for different purposes
- Discuss the effects of human actions on the environmental health and mauri of Clearwater catchment

Resources

Poster 4: Clearwater catchment

BLM 27: The story of Clearwater and its catchment

BLM 28: Role cards

BLM 29: Roles in the catchment

Vocabulary

audit, bore, community, copper, developer, development, forestry, harvest, heavy metals, households, nutrients, pesticides, plantation, properties, residents, role, restoration

BLM 27: The story of Clearwater and its catchment

Originally, most of Clearwater was covered in bush. The Clearwater stream ran through the catchment, free and uninterrupted. Native animals and plants lived in abundance in and beside the clean, clear stream.

Gradually, over time, people came to Clearwater. They made their homes in the catchment and changed the environment so that they could live more easily. Over the years they cleared bush to make way for farms, housing and places to do business.

Many groups of people now live, work and play in Clearwater. They all affect the health of the stream and the catchment. Some residents are damaging the stream, even though they might not be aware of it. Daily decisions in their lives such as the way they travel, what they buy, where they get their supplies from, how they use energy and what they choose to do with their waste all have an impact on the mauri of the catchment. The local landfill is running out of room and soon the price for taking waste to the landfill will increase.

Recently the Greater Wellington Regional Council tested the health of the streams in Clearwater. They also monitored the outflow where the river runs into the sea. The results have been alarming. There were very low numbers of aquatic insects and native fish in the streams. High levels of pollution were found and the council has issued a statement to the residents saying it is not safe to swim in the sea near the river outflow. The council believes that the residents of Clearwater are having an impact on the health of the streams and rivers in the catchment.

There are a number of residents who want to help the catchment and some are trying to get people in the community to talk to each other about how to best deal with the pollution.

A small group of Clearwater residents have set up a new community care group and are planning to plant more native plants and trees alongside the streams and river. Their goal is to attract more native birds and fish into the catchment. Both the Department of Conservation and Greater Wellington Regional Council are already working to protect the native animals and plants in the catchment by helping to control pests and assist the community group to restore biodiversity. The community group would like to see each side of the stream planted with natives in a wide strip and these strips fenced off so that livestock can't enter the stream.

Local iwi, as kaitiaki, want to help to restore the mauri of the streams and river. They believe that the mauri of the Clearwater catchment must be enhanced and management of the catchment must respect this life force. They are keen to participate in discussions about how to improve the health of the catchments waterways.

The Clearwater River and its tributaries were once a valued food source for the iwi. Now the stream is too polluted to eat the watercress or take whitebait. Some of the animals that were once in the stream are now gone. They hope that in the future they will again be able to safely harvest food from the river and streams.

The residents of Clearwater want to make sure that they, and future generations, continue to enjoy a safe and healthy place to live and play. They are very concerned about the current state of their catchment and want it to change for the better. They want to restore the beauty, identity and diversity that was once a natural part of the catchment. They want Clearwater to be sustainable, so that residents can continue to live and work in the catchment while its natural features and habitats are also protected and enhanced.

BLM 28: Role cards

Farmer

The dairy farm has been in the family since the 1800s. It provides food and milk for Clearwater residents and businesses. The farmer has fenced off and planted a large area of native trees and plants on the steeper hills of the farm. This provides good habitat for native animals such as birds, insects and lizards.

The farmer doesn't have much space on the farm for grazing cows so he lets them graze right up to the stream edge. The cows can go into the stream to drink, so the farmer doesn't have to provide drinking water for them. To fence off the stream and provide drinking water for his cows would cost a lot of money.

Cows going in and out of the stream cause erosion of the stream banks. Whenever the cows go into the stream they poo. The nutrients, from the poo, cause long algae and other weedy plants to grow in the stream. Long algae destroys animal habitat and uses oxygen. Aquatic weeds slow down the flow of water and block light from the stream.

The farmer takes water from the stream every day using a pumping system. This water is used to irrigate (water) his paddocks. He does this all year round and has permission from the council to take the water. He is only allowed to take a certain amount of water but he has no way of measuring how much is taken.

Developer

The developer builds new houses for the people of Clearwater. The new housing in the upper catchment will make Clearwater a popular area to live. More people will want to come to Clearwater and the house prices will increase. This is good for Clearwater residents when they want to sell their houses.

Before building starts, some of the land will need to be flattened. Soil will be removed to make the sections of land flat. This will create a lot of sediment and some of this sediment could end up in the stream. Some parts of the stream may need to be piped.

The developer wants to make streamside houses, as people love to live by the water. The land right up to the stream has been cleared of trees to make way for homes with good views. Having no trees next to the stream means that sediment from the earthworks can enter the stream more easily. There is also more chance of erosion.

All houses get a lot of sunshine throughout the day. The developer is looking at different ways to heat the houses.

Factories

Factories in Clearwater make useful products and provide jobs for residents. The factories have their own recycling station for glass, plastics, and paper so that they can easily recycle. This has reduced the amount of waste going to the landfill.

A road has been built to allow cars and trucks to travel easily between the town and the factories. A culvert was built to enable cars and trucks to cross the stream safely. Unfortunately this culvert was poorly designed and it now hangs above the stream, stopping fish from swimming upstream. Large trucks delivering goods to and from the factories drive along the stream roads. Cars and trucks leave rubber, oil and petrol on the road. These pollutants are washed into the stormwater system and the stream. They can poison the plants and animals in the stream.

The factories recently had an energy audit carried out on their buildings. The audit found that just about as much energy is used at night as during the day. This is because many computers, lights and appliances are left on at night by staff.

BLM 28: Role cards

Households

There are many new people coming to live in Clearwater. People enjoy using the streams and river for kayaking, fishing and walking nearby. Houses with views of the river and streams are very popular and are often the most expensive homes in the catchment.

Many households use chemicals to clean mould from their decks and patios. These are then hosed off. The water washes the chemicals into the stormdrains and into the streams or river. This pollution can poison aquatic plants and animals.

There are many beautiful gardens in Clearwater. People love their gardens and water them regularly, especially during summer. Some people water their gardens in the middle of the day and others more than once a day.

Many people throw their weeds and other garden waste beside the stream because they don't want to pay to take their waste to the landfill. This causes weeds to grow around the stream. Some of these weeds stop native plants from growing.

Some people living near the stream don't want to plant taller trees on their properties as taller trees block the view of the water.

Clearwater School

Clearwater School is right next to the stream. The students have learnt a lot about the stream and the plants and animals that live in and around it. They have planted the edge of the stream with native plants and the Board of Trustees arranged for the area to be fenced off. The fence keeps students out of the stream and the planted area.

There are few native trees or plants in the school grounds, but there is plenty of grass. The students hardly ever see native animals or birds around their school.

Students at Clearwater School produce a lot of rubbish. Most of their rubbish is paper and wrappers from school lunches. The bins at the school are often full and sometimes rubbish from the playground blows into the stream. The students have fast food days on Fridays and this creates even more rubbish than on a usual day. Their biggest waste problem is the large amount of food waste that ends up in the rubbish bins and then gets sent to the landfill.

The local landfill is running out of room, and soon the price for taking waste to the landfill will increase.

Forestry company

The forestry company gives many Clearwater residents jobs. Timber is sent overseas to make wood and paper products. The forestry trees prevent erosion and provide some habitat for birds.

The trees used in the plantation are pines because they grow quickly and make excellent wood. Pines are not native to New Zealand. The animals and plants which live in pine forests are different to the animals and plants that live in native forests. This is because pine forest habitat is not suitable for many of our native plants and animals. In the pine forest there are also introduced animals like rats, hedgehogs and stoats that eat native animals.

The forestry company uses every bit of space to grow pine trees, so trees are grown as close to the stream edge as possible.

When pine trees are harvested there can be damage to the waterways. If it rains when the trees are removed, the top layer of soil may be washed into the stream. More water will run off the bare ground, without being absorbed by trees, and go straight into the stream.

BLM 28: Role cards

Vineyard and Orchard

The orchard and vineyard produces fruit, wine and vegetables for the residents of Clearwater. People love to visit the orchard's café and buy their fruit and vegetables directly from the orchard.

The orchard needs a lot of water to enable the plants to grow strong and healthy. Water is taken from the groundwater through a bore. A bore takes water from deep in the ground, which can lower the levels of water around it. In mid-summer a lot of water is taken and water levels get very low. This can also affect the amount of water in the stream. During winter the orchard does not need to take water.

During the colder months of the year the plants and vines need pruning and the waste from the plant pruning is collected by the local landfill.

Fertilisers are often used on the crops. These fertilisers help the plants to grow faster but are sometimes washed into the stream by rain and increase the growth of algae and weeds in the stream. Chemicals used to kill pest animals are also sometimes washed into the stream.

Offices / businesses

The offices and businesses in Clearwater employ many people in the catchment. They have decided to sponsor the new community care group in the catchment that want to help the local environment. Several businesses and office blocks have decided to become more sustainable. They have completed waste and energy audits to find out what they can do to reduce their impact on the environment, although they haven't made any changes yet.

One business has a large skip bin outside it which several businesses use. There is a lot of waste produced so the skip bin is emptied twice a week and the waste from it goes to the landfill.

There are more offices and businesses coming to Clearwater all the time. An extension of the buildings and a new carpark is planned. The new carpark will be a large hard surface, which means the rain water can't soak into the ground. All the rain that falls on the carpark will flow into stormwater drains that will flow into the stream. Part of the stream will be piped under a new carpark.

Most employees in the offices and businesses drive their cars alone to work. A "bike to work" week was not very successful as few new people took their bikes to work.

BLM 29: Exploring your role in Clearwater catchment

Role:		
What actions are you responsible for that may have an impact on the catchment?	Why are you doing it?	Effects on the mauri of the catchment

15b Clearwater catchment scenario

Introduction

- Write learning intentions on your board and read through these with students.
- Introduce the idea of hot-seating. Hot-seating is when students take on a role and other students question or interview that person to bring out information, attitudes and ideas about their role. Each group will have a turn in the hot seat and will answer questions and comments about their role.

Activity instructions

- Describe appropriate questions for hot-seating and record on the whiteboard as prompts.

  Phrases such as those suggested below can be used as starters for questioning:

  "Can you tell us more about...?

  As kaitiaki what are you doing to...?

  Is there another way you could ... ?

  Can you ... instead of...?

  How does your activity affect the mauri of.... ?

- In groups, students brainstorm examples of questions they may ask other groups.
- They also need to consider the questions that others will ask their group and start to formulate responses.
- Ask for a volunteer (representative from each group) to be hot-seated by the rest of the class. The other members of the group stand behind this student and offer support and replies when they are unable to answer a question. Members of the group can move into the hot-seat when they answer a question.

  The class questions this group for a set time. The questions should encourage thinking about alternatives to each group's current actions.
- Repeat the process for the other groups until all roles have been examined.
- Direct students to Poster 4

  ? How will the mauri of the catchment be affected if residents continue to act as they have been?

  The mauri will continue to weaken until the catchment has been completely degraded.

Conclusion

- Back in their individual role groups, students discuss the issues and possible alternative actions that were raised for their group during hot-seating.
- De-role by shaking out or brushing off the role they have assumed.

Learning intentions

Students will…

- Use 'hot seating' as a drama tool to further investigate people's views
  (context - residents of Clearwater catchment scenario)
- Understand how people view and use places differently
  (context - residents of Clearwater catchment scenario)

Success criteria

Students can…

- Use questioning skills to investigate other residents views of the catchment and how they use and look after it

Resources

Poster 4: Clearwater catchment

BLM 28: Role cards

BLM 29: Roles in the catchment

Vocabulary

hot-seating, representative, role

15c Clearwater catchment scenario

Introduction

- Write learning intentions on your board and read through these with students.
- Explain to students that it is now time to use their knowledge about catchments to plan how best to enhance and restore the mauri of Clearwater catchment.

Activity instructions

- Working in their resident groups from the previous activity students need to plan, as good kaitiaki, changes to their area of the catchment that will enhance the mauri, while also being achievable and affordable.
- Together they will draw the alternative action ideas and future vision for their area of the catchment onto the appropriate BLM (30-37). For example the farmer group will draw their future vision for the farm only on BLM 30.
- When groups have illustrated their catchment areas, they will then present their vision (and illustration) to the class. They need to prepare for this presentation by discussing answers to the following questions. Groups need to be prepared to justify their changes to the other members of the catchment.

  ? What are the alternative actions that can be taken?

  How will these actions enhance and restore the mauri of the catchment?

  How will these actions effect other residents in the catchment?

  How will these actions impact financially on you?

Conclusion

Collect all BLM's together to form a new picture of the whole catchment. Compare this picture to Poster 4 of the original Clearwater catchment.

? How will these combined actions improve the overall mauri of the catchment?

Learning intentions

Students will…

- Use their knowledge about an issue to develop some possible positive actions (context - Clearwater catchment scenario)

Success criteria

Students can…

- Develop possible alternative actions that will improve the mauri of Clearwater catchment

Resources

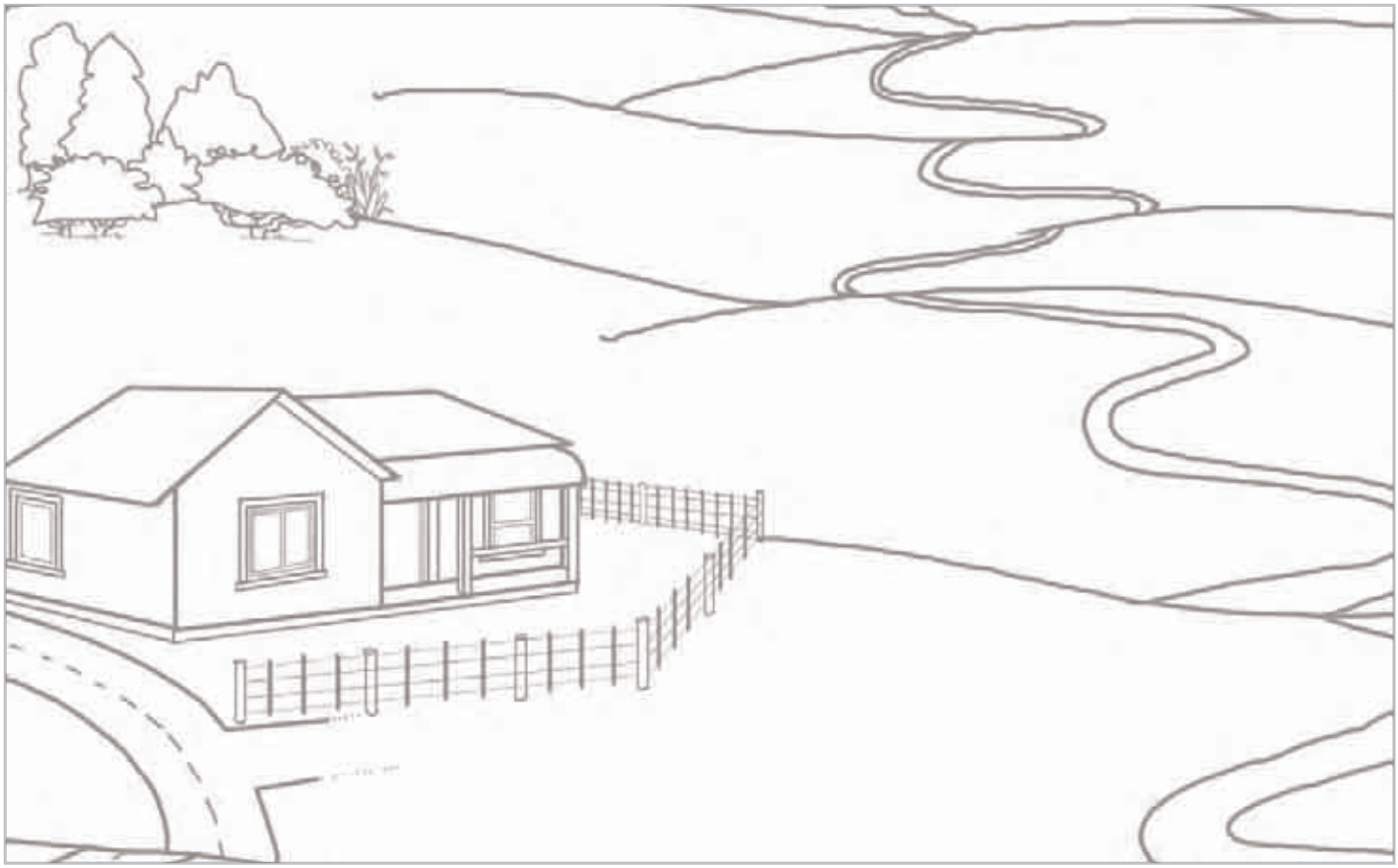
Poster 4: Clearwater catchment

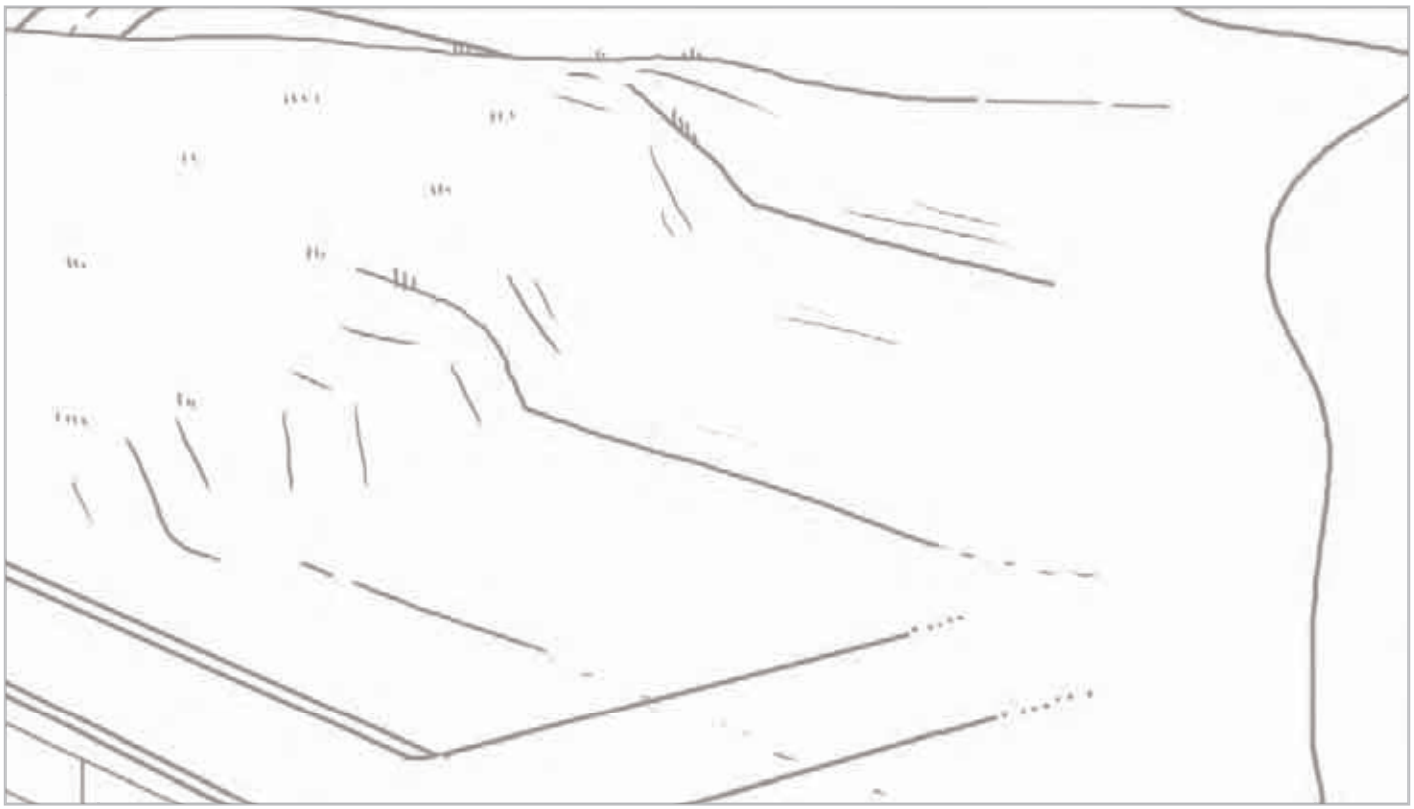
BLMs 30-37: The future of Clearwater catchment

Vocabulary

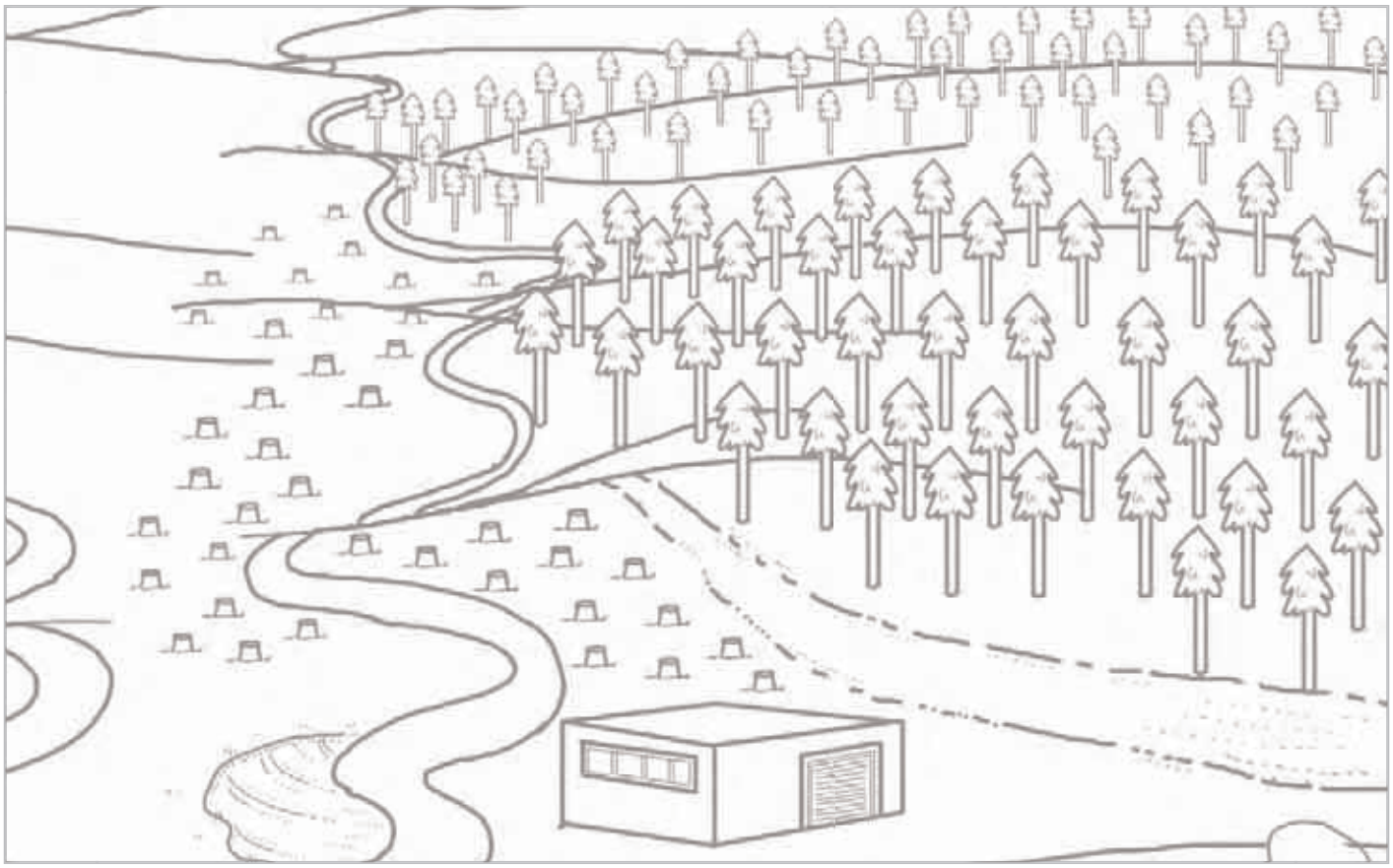
advise, vision

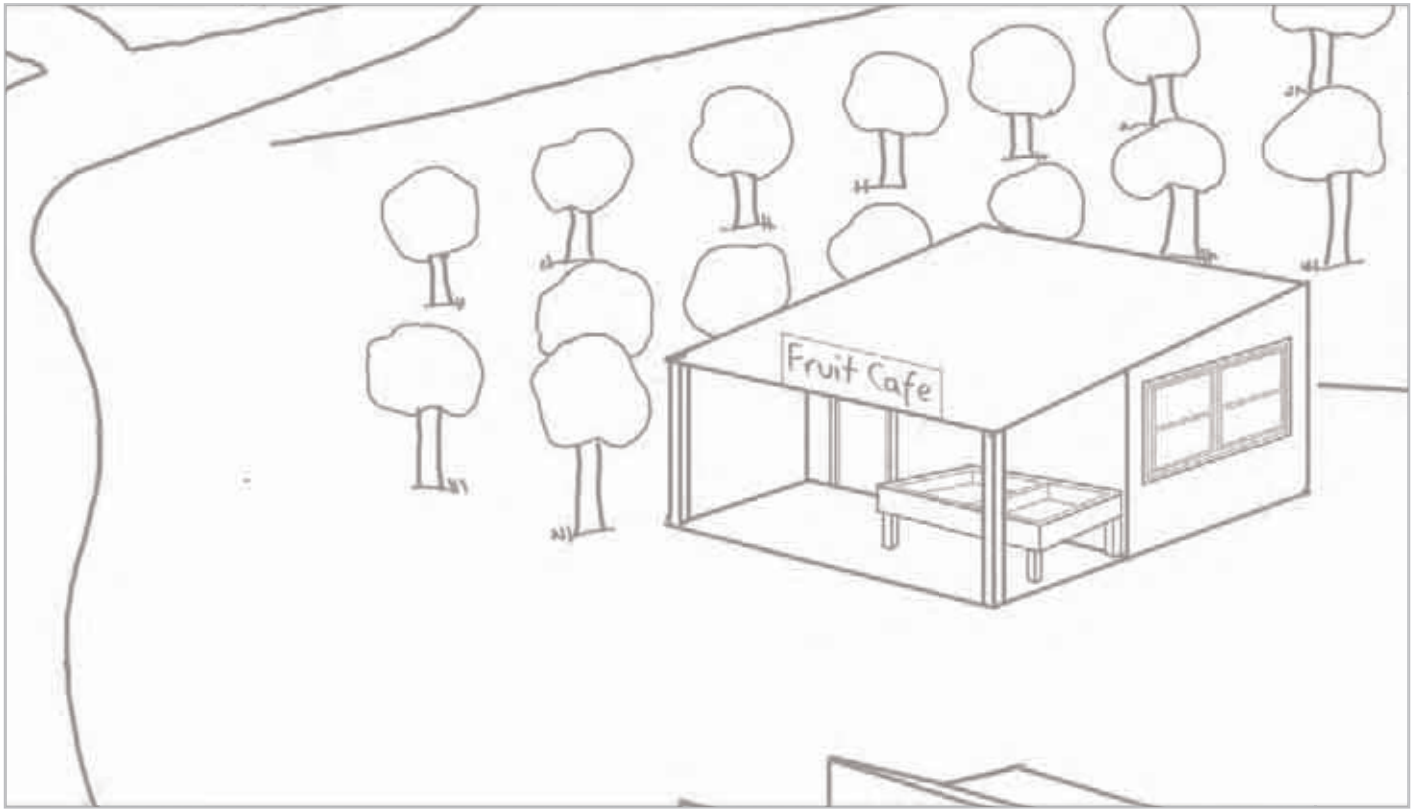
BLM 30 (farmer) and BLM 31 (developer)



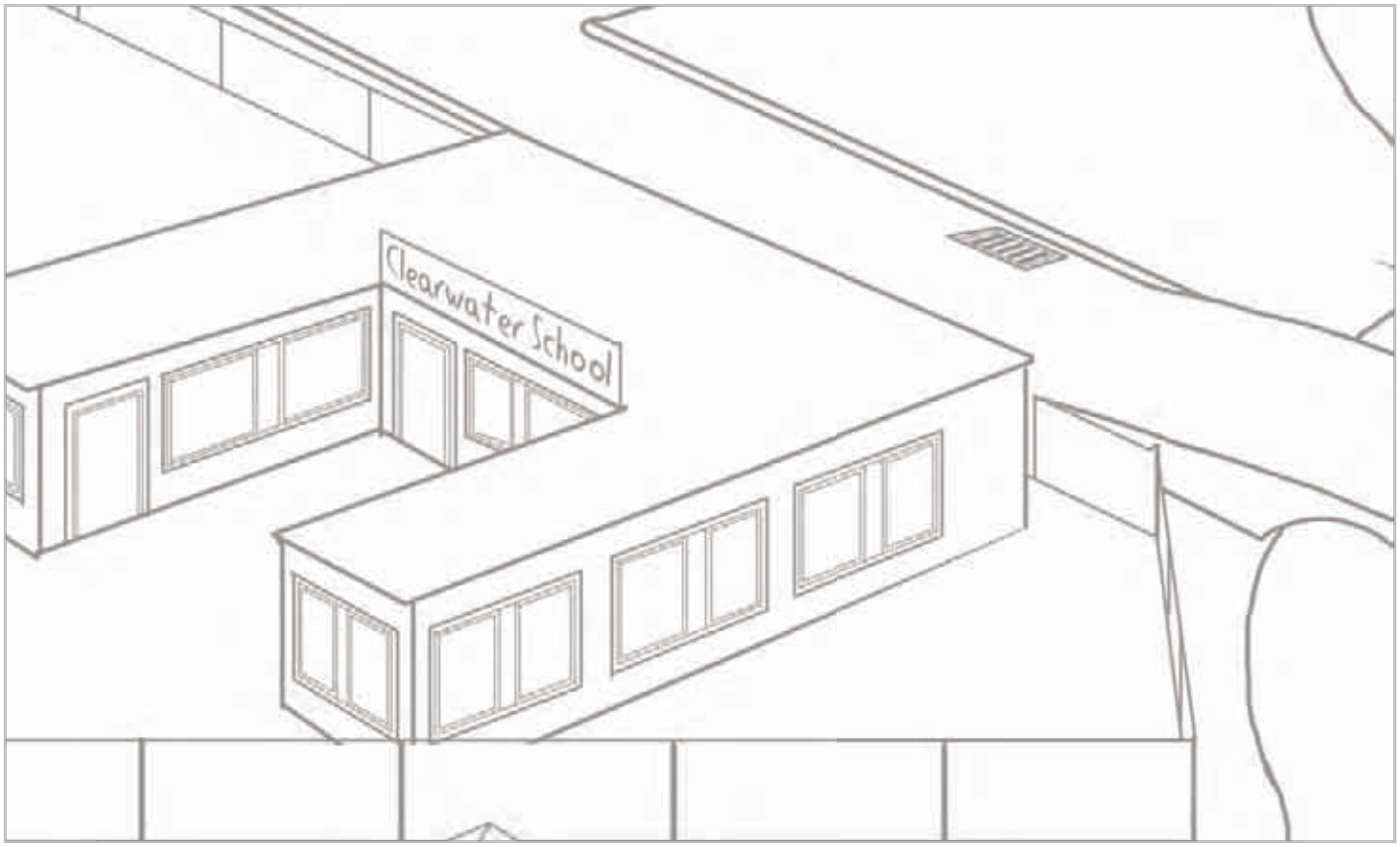


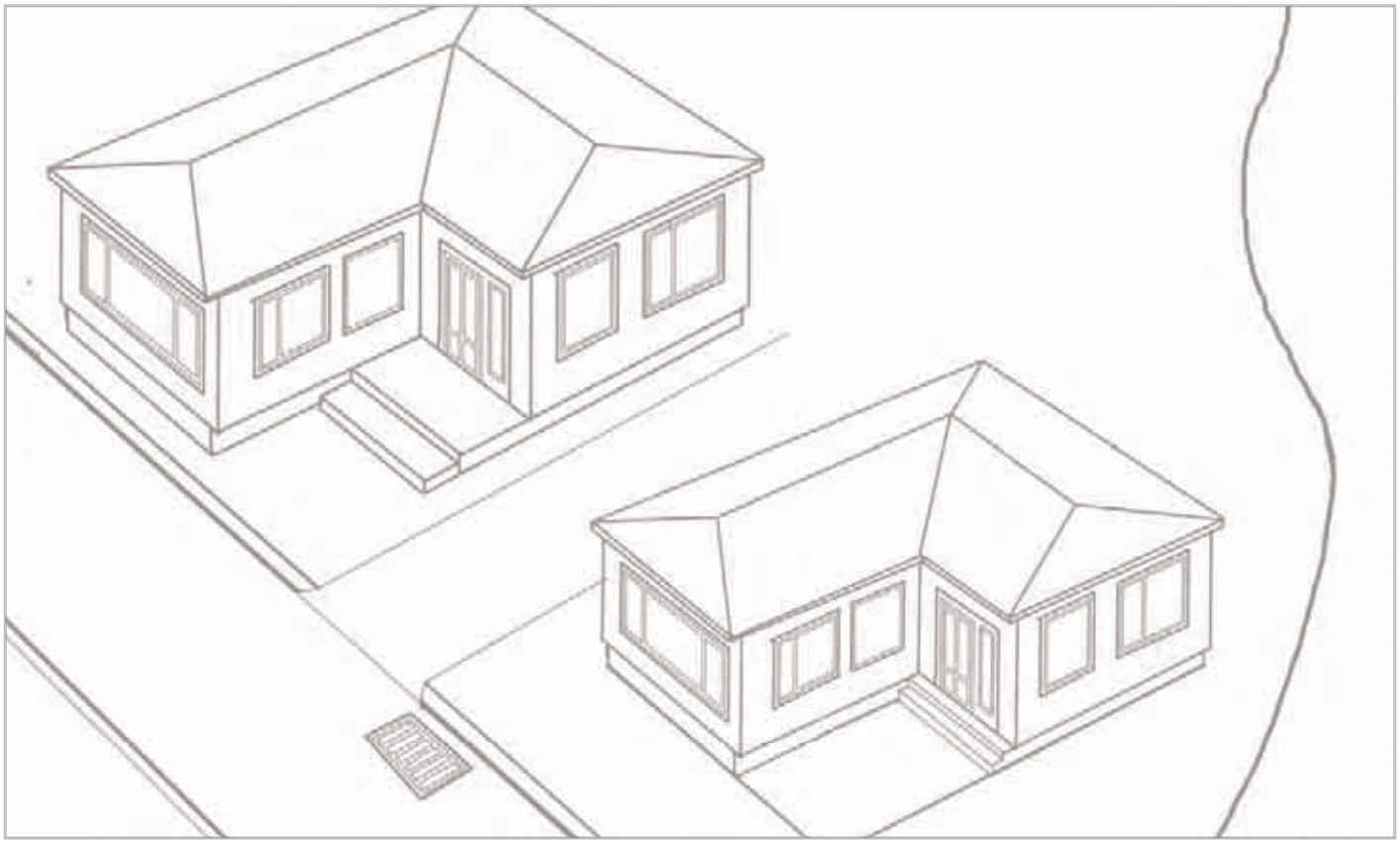
BLM 32 (forestry company) and BLM 33 (orchard / vineyard)





BLM 34 (school) and BLM 35 (households)





BLM 36 (factories) and BLM 37 (offices / businesses)