ENVIRONMENTAL EDUCATION RESOURCE UNIT

Water in the Wanganui District

An addition to Kura Kaitiaki: Water Conservation

horizons
regional council

Acknowledgments

Water in the Wanganui District, an addition to Kura Kaitiaki: Water Conservation was compiled by Helen Thomas (Environmental Educator, Horizons Regional Council) with the help of teaching resources from Greater Wellington Regional Council. Their support with the development of this resource and their willingness to share their own resources has been greatly appreciated. Special thanks to Srian Fonseka and Dave Rudolph (Wanganui District Council) for their invaluable input and their guidance and support in compiling the district information.

May 2014
Document No. 2014/630

11 - 15 Victoria Avenue
Private Bag 11 025
Manawatu Mail Centre
Palmerston North

T 0508 800 800
F 06 952 2929
help@horizons.govt.nz
www.horizons.govt.nz

Facebook
www.facebook.com/horizonsregionalcouncil
Twitter
@horizonsrc

How water gets to our taps

SECTION 5

This section explores how water is delivered from water collection areas to our taps.

SECTION 5

Section 5: How water gets to our taps

PURPOSE

The purpose of this section is to help students to:

- Understand how water gets from the water collection area to their taps.
- Understand that getting water to taps takes time, energy and money.

Overarching concepts for Section Five:

- Water is collected from aquifers and groundwater and is distributed through a network of pipes to residents.

Learning experiences	Learning intentions Students will:	Curriculum links (Achievement objectives)	Content
1. Our water supply	• Understand how drinking water is collected for their water supply • Identify where their drinking water is collected from	**Social Sciences: Level 4** Understand how producers and consumers exercise their rights and meet their responsibilities	Students examine a map describing the water sources and water collection areas. They then identify where their water comes from and how it gets to their school
2. Water's journey to our taps	• Understand how drinking water gets from water collection areas to taps • Identify who is responsible for delivering water to residents	**Social Sciences: Level 4** Understand how producers and consumers exercise their rights and meet their responsibilities **Technology: Level 3** **Nature of Technology** *Characteristics of technology* Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function	Students order steps in the process of getting water from the water collection area to our taps
3. The right water in the right place	• Recognise the difference between treated water, untreated water, greywater and wastewater • Describe safe uses for the different types of water	**Social Sciences: Level 3** Understand how people make decisions about access to and use of resources **Health: Level 3** **Personal Health and Physical Development** *Safety management* Identify risks and their causes and describe safe practices to manage these	View examples of treated drinking water, untreated water, greywater and wastewater. Learn about the differences between the types of water and describe appropriate uses for each
4. No water supply for a day	• Understand the possible effects of an earthquake on the water supply network • Plan the use of emergency water supplies during a natural disaster	**Health: Level 3** **Personal Health and Physical Development** *Safety management* Identify risks and their causes and describe safe practices to manage these **Social Sciences: Level 4** Understand how people participate individually and collectively in response to community challenges	Students are led through a scenario involving a fictional earthquake. They investigate the possibility of a disrupted water supply and make plans to prioritise emergency water use

5:1 Our water supply – teacher notes

Background knowledge

Methods of water collection

There are a variety of different methods used around New Zealand to get water to our taps. These include:

1. Collection from roofs directing rainwater into tanks.
2. Pump systems in streams to transport water to houses.
3. Intake pipes to divert water from rivers into water treatment plants and then into a piped network.
4. Bores and wells to extract water from the ground directly to homes or to a piped network.
5. Dams to collect surface water.

The worldwide situation

In New Zealand, most people receive water that is diverted from rivers into a piped network. Worldwide, only 5 out of 10 people have some kind of connection to a piped water supply in their homes. Two out of 10 people don't have any access to a treated water supply[1].

Water collection areas in Wanganui

Approximately 42,000 people call the Wanganui District home with almost 35,000 living in Wanganui city itself. In the city some 17,000 homes are connected to the urban water supply. There are three water collection areas that draw water from deep within the Nukumaru Aquifer then distribute through the network of pipes to our taps.

- 65% of this water comes from the Kai Iwi artesian wells.
- 20% comes from the Heloise bore.
- 15% comes from the Aramoho bore.

The Kai Iwi Wells

These artesian wells that draw water from deep within the Nukumaru Aquifer were constructed around 1965. The wells are the major water source for Wanganui city. Each well is 100-175 metres in depth, and has a submersible pump installed. Combined, they contribute around 30 million litres per day to the water supply. The water is piped to the Westmere Reservoirs for treatment and storage.

Curriculum links

Social Sciences: Level 4
Understand how producers and consumers exercise their rights and meet their responsibilities

Other curriculum links: L 3 and 4
Mathematics: Geometry and Measurement
Technology: Nature of technology

Education for sustainability concepts

Interdependence/ Whanaungatanga:
Everything and everyone in our world is connected

Equity:
Respect for all life, social justice, intergenerational equity, finite resources

[1] World Business Council for Sustainable Development. n.d. Facts and Trends: Water. Geneva: WBCSD. URL: http://www.wbcsd.org/web/projects/water/Water%20Facts%20and%20 Trends%20-PPT.pdf Retrieved June 2010.

The Heloise Bore

The Heloise Bore was drilled in 2010 and is 600 metres in depth. It was commissioned in 2011 and can supply around 5.0 million litres per day. The water is also piped to the Westmere Reservoirs for treatment and storage.

The Aramoho Bore

The Aramoho Bore was drilled in 1996 and also taps into the Nukumaru Aquifer. The bore is 550 metres in depth. The treatment plant was constructed and commissioned in September 2003. The bore can supply around 3.3 million litres per day. The water is treated directly at the bore site and supplied to homes in Aramoho.

Westmere Reservoirs

The main reservoirs, situated by Westmere Service Station, have two main functions:

- To balance the fluctuating demand from the city's distribution system against the output from Kai Iwi.
- To act as a safeguard for the continuance of the supply should there be any breakdown at the source (Kai Iwi) or on the main trunk pipelines (Kai Iwi to Westmere). The reservoirs provide approximately 36-72 hours storage.

The reservoirs consist of three separate but interconnected structures each of 23 million litres capacity (a total capacity of 69 million litres).

Bastia Hill Water Tower

Building of the tower began in 1925 and was completed in August 1927. It was the largest tower in the Southern Hemisphere and the third largest tower in the world at that time.

The average water pressure throughout the city ranges from 300-500 Kilopascals (approx. 43-71 psi). This is not sufficient to give houses in Bastia Hill and Durie Hill a reasonable flow of water at an acceptable pressure and therefore water to these areas is fed from Bastia Hill Water Tower, which acts similarly to Westmere Reservoir. Water is pumped to the tower from the pump station located in Ikitara Road from a mix of the three water collection areas. The tower has a capacity of 560,000 litres.

5:1 Our water supply – learning experience

Learning experience

- Share learning intentions and success criteria.
- Turn on a tap in the classroom. Ask students if they know where the water in the tap comes from. Discuss their ideas.
- Explain that water from the tap originally comes from the Nukumaru Aquifer and pumped from one of three water collection areas; the Kai Iwi Wells, Heloise Bore and Aramoho Bore.
- Display the poster "Water Supply Network" and identify the water collection areas. Explain how water is collected; briefly explain how wells access water from an aquifer *(see teacher notes)*.
- Hand out 5:1a. Draw attention to the water collection areas and talk about which one might provide water to your school. Mention the pipes which carry the water from the water collection areas to the suburbs. Ask students to highlight the closest water collection area and attempt to trace the path of the pipes from this area to the suburb where your school is. Use the poster as a guide.
- Ask if any students are not on town supply and discuss alternatives to town supply.

As an extension, students could trace the pipe network from the water collection areas to their home/hospital/ airport or other familiar landmarks.

Reflection questions

- Where does water from a bore come from?
  The water collected from a bore is called groundwater and comes from rain, rivers and streams seeping down through layers of soil and rock which hold the water and allow its slow movement underground. The areas of "held" water are called aquifers.
- What would happen if there was no water available at one of the water collection areas?
  Water from another collection area would be used, however water restrictions might be put in place. The pipe network is designed to be able to deliver water from most water collection areas to most suburbs.

Vocabulary

- Nukumaru
- Aramoho
- Westmere
- Heloise
- Kai Iwi
- Bastia Hill
- reservoir
- aquifer

Learning intentions

Students will:
Understand how drinking water is collected

Identify where their drinking water is collected from

Success criteria

Students can:
Show where their water is collected from and what path it takes on a map

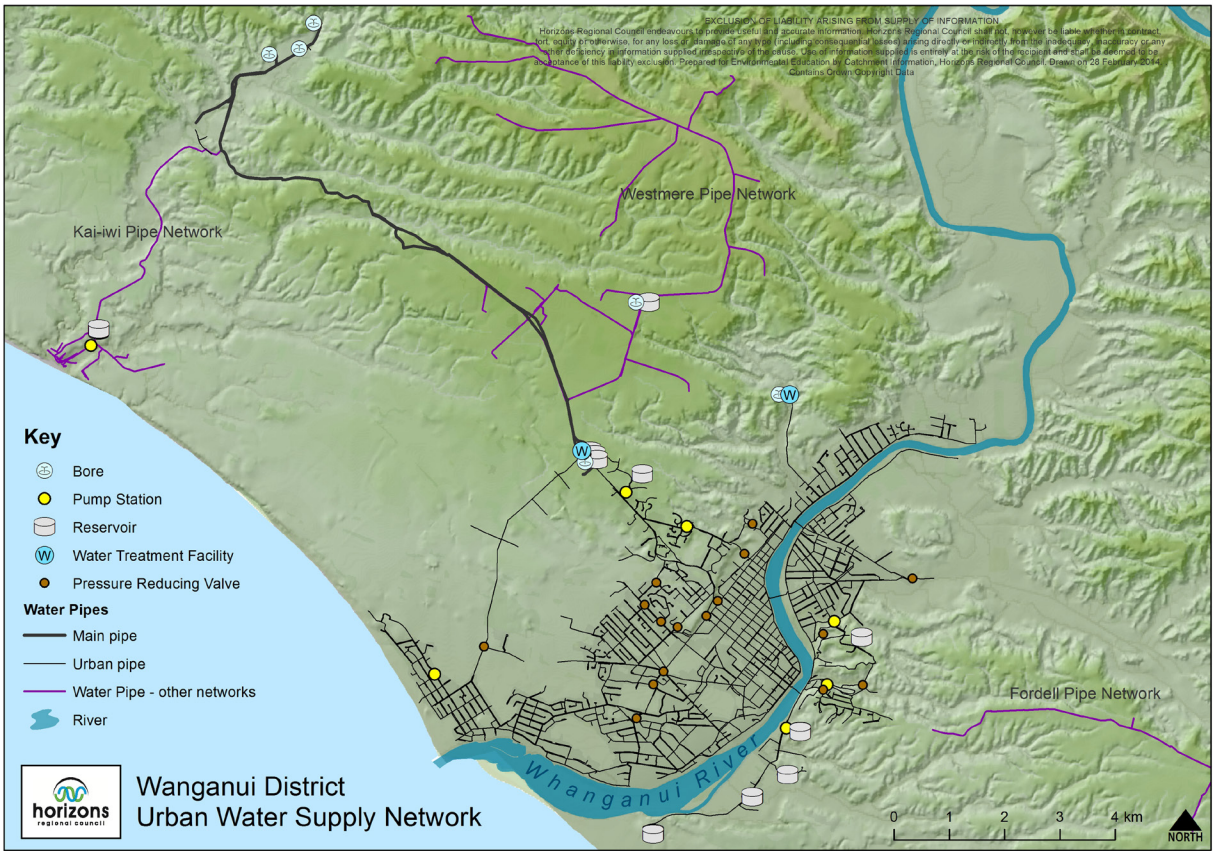
Explain how water is collected at the water collection areas

Resources

Poster: Water supply network

5:1a The source of our drinking water

5:1a The source of our drinking water



Identify the water collection area(s) where your drinking water comes from. Trace the path(s) of the main pipes from the water collection area to your school.

How is water collected from this area? (explain in your own words)

5:2 Water's journey to our taps – teacher notes

Background knowledge

Water's journey through the pipe network

From a water collection area, water takes a complicated journey through a series of pipes before it finally ends up in our homes or workplaces. The network has a total of 3 reservoirs, 1 tank, 8 pumping stations and over 400 kilometres of pipelines.

The cost of providing water

It costs approximately $750,000 a year in power costs to pump water from the wells and bores to the reservoirs alone. It actually costs even more to get the water treated and supplied to households. Therefore, the less water used by households means it costs the Wanganui District Council less to attain it.

Water distribution

Most of the water supply network is underground, and we hardly ever see it. If you dug up the area around your house, you would find evidence of the pipe network and in some steep hillside suburbs, you might see some exposed pipes.

Gravity and pumping water

The piped network operates with the help of gravity and pumping stations which boost the flow of water in the pipelines up hills. Gravity assists the flow of water downhill.

Reservoirs store water on its way to residents, balancing out differences in the amount of water being treated and the amount being used. Reservoirs can also be a supply of water when the main supply is disrupted.

Maintenance

A network of meters and gauges monitor the flows and levels in reservoirs and pipes. Water delivery systems are expensive to maintain.

Water pipes

Although you may think that our drinking water is really important and therefore would need a large pipe, generally domestic connections are only 20mm (or 2cm) in diameter. It connects to a larger water main pipe in the street. Water main pipes in streets are between 100-300mm (or 10-20cm) in diameter. The bulk water pipes from the Kai Iwi wells to the Westmere Reservoirs are the largest in the network at 450-550mm (45-55cm) in diameter.

Curriculum links

Social Sciences: Level 4
Understand how producers and consumers exercise their rights and meet their responsibilities

Technology: Level 3
Nature of Technology
Characteristics of Technology
Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function

Other curriculum links: L3 and 4
Social Sciences
Science: Investigating in Science

Education for sustainability concepts

Interdependence/ Whanaungatanga:
Everything and everyone in our world is connected

Sustainability/Hauora:
The choices we make today affect the choices we can make in the future

5:2 Water's journey to our taps – learning experience

Learning experience

- Share the learning intentions and success criteria.
- Examine the pipes connected to the taps in the classroom and attempt to trace where they go next. Ask students how water gets from the water collection area discussed in the previous learning experience to the taps at school or at home. Encourage further detail than just the pipe network. If you are able to, view local examples of reservoirs, pumping stations and water pipes below ground.
- Explain that water has weight and is heavy. Use an example of a bucket filled with water to illustrate this. Invite students to try to lift the bucket full of water.
- Explain that effort and energy is required to move water uphill (against gravity). Water will always try to flow downhill (with gravity). Ask students how the movement of water uphill might be possible. Briefly explain how pumps assist the process.
- Ask students if they know who is responsible for delivering water to residents. (Wanganui District Council provides the water and delivers it to reservoirs as well as then delivering it from the reservoirs to the taps.)
- Hand out 5:2a. Point out the reservoir. Ask students to share their ideas about what a reservoir does.
- Ask students to cut out the squares showing the stages of water's journey to our taps on 5:2a and put them into the correct order. They could also record notes about each stage of the process.
- Share answers on 5:2a answer sheet and discuss.

Reflection questions

- If there was no town supply, how would you get water? *Answers will vary e.g. collect rainwater, emergency supplies etc.*
- How does the council know if there is a problem with the water supply network? *See teacher notes.*

Vocabulary

- gravity
- pumping station

Learning intentions

Students will:
Understand how drinking water gets from the water collection area to their taps

Identify who is responsible for delivering water to residents

Success criteria

Students can:
Order the steps in the process of delivering water from the water collection area to tap

Describe who is responsible for delivering their water

Resources

5:2a Water's journey from collection area to tap

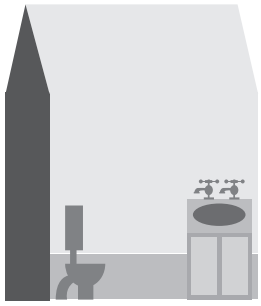
5:2a Water's journey from water collection area to tap

Cut out the cards below and arrange them in the correct order to show water's journey from the water collection area to the tap.

Explain each step of the journey in your own words.

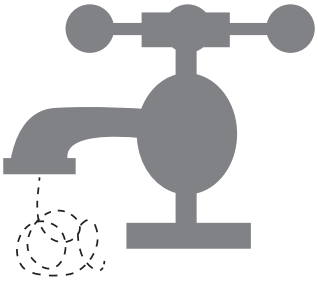
Pumping station

Pipes in your house

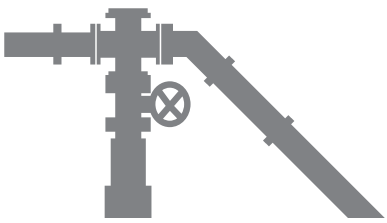


Reservoir
(large holding tank)

Tap

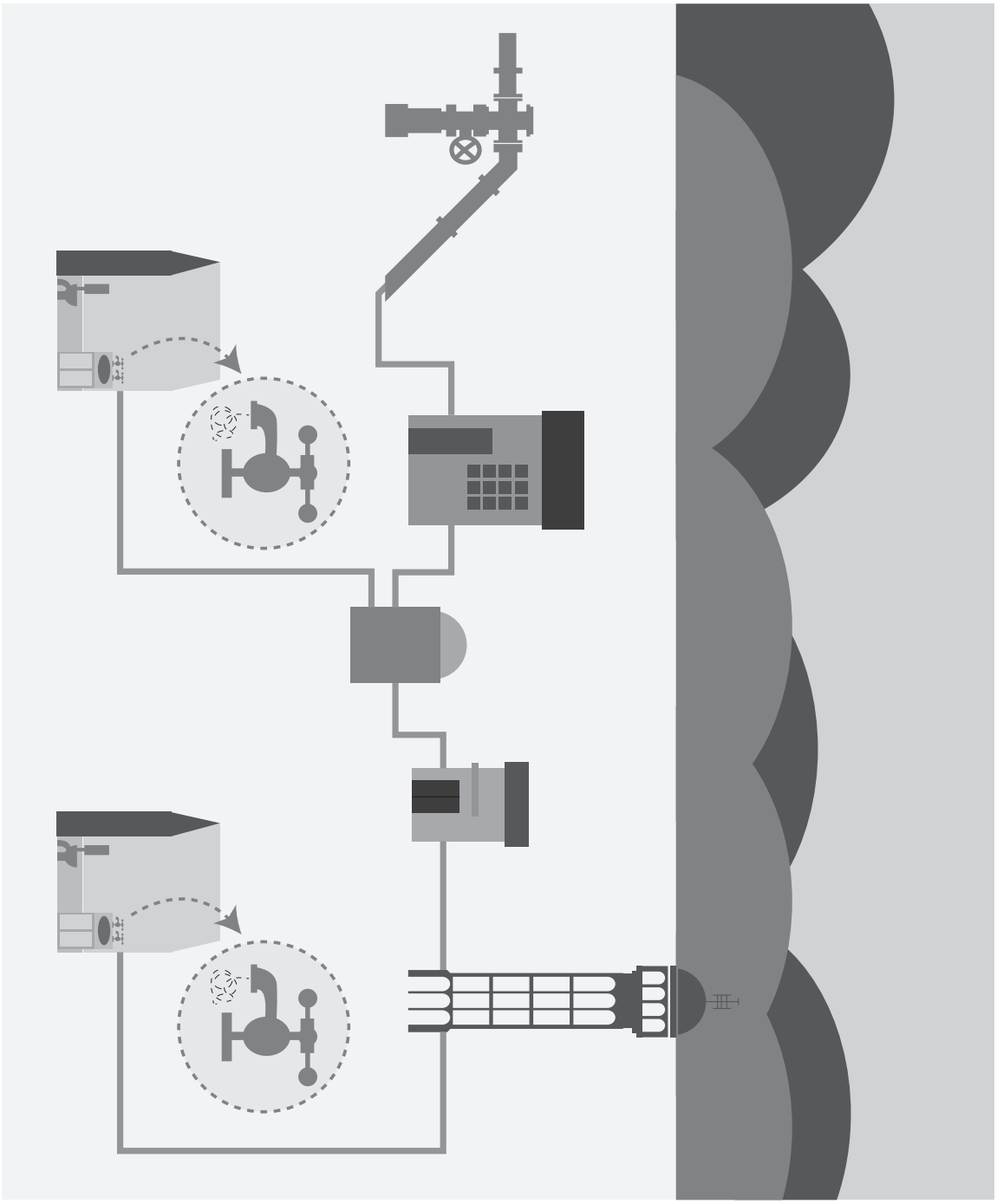


Water collection area



Water treatment plant

5:2a Water's journey from water collection area to tap – answer sheet



5:3 The right water in the right place – teacher notes

Background knowledge

Water quality

Water in the environment will always carry with it varying levels of impurities, such as metals, bacteria or organic matter. Sometimes we can see these impurities (e.g. dirt/grit), but often they are so small that the water could look perfectly clear and still be carrying them.

Water from different sources will contain differing levels of a variety of impurities, depending on the environment it has passed through. Some of these impurities can be harmful to our health.

Greywater

Greywater can be defined as the left-over water from baths, showers, hand basins, and washing machines. It is not free from impurities like treated water. It can be contaminated with waste (e.g. soap, dirt). Greywater can be re-used on gardens or for outdoor use.

Wastewater

Wastewater is water that has been contaminated with human waste and cannot be re-used. Wastewater enters the sewage system and is treated at a sewage treatment plant before being discharged.

Wastewater hazards

Wastewater can contain bacteria, fungi, parasites or viruses that can cause serious infections in humans. It is not to be handled.

Why re-use water?

Often people use treated, drinking-quality water for activities that don't require drinking-quality water, for example, watering the garden or flushing the toilet.

In many countries it is common to re-use greywater for these purposes. To ensure a steady supply of water for future generations and for a larger population we may need to start re-using greywater more in the future. A greywater recycling system cuts down demand for drinking water and reduces the pressure on our water supplies.

Pressure on the water supply

The more water we use, the more 'pressure' we put on the water supply to meet our demands. If everyone used water carefully and used more water efficient appliances (washing machines, dual flush toilets etc) there would not be as much demand for water and the current water supply would be adequate.

Curriculum links

Social Sciences: Level 4
Understand how producers and consumers exercise their rights and meet their responsibilities

Technology: Level 3
Nature of Technology
Characteristics of Technology
Understand how society and environments impact on and are influenced by technology in historical and contemporary contexts and that technological knowledge is validated by successful function

Other curriculum links: L3 and 4
Social Sciences
Science: Investigating in Science

Education for sustainability concepts

Sustainability/Hauora:
The choices we make today affect the choices we can make in the future

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

5:3 Water's journey to our taps – learning experience

Learning experience

Before beginning the activity, set up four glasses of water – treated, untreated, greywater, and wastewater (as described in resources on bottom right).*

- Share the learning intentions and success criteria.
- Display the four numbered glasses of water. Describe what treated water means and explain that one of the four glasses is treated water (out of the tap).
- Write a definition for treated water and record the definition.
- Explain the differences between the other types of water (untreated, greywater and wastewater). Together write definitions of these types of water.
- Ask students to guess which types of water are in each numbered glass. Ask them to justify their answers. Reveal the contents of each glass.
  Discuss differences in appearance of each type of water.
- As a class, discuss the quality of the treated water that comes out of the tap. Ask students how we use water from the tap. Are there some activities that we use drinking-quality water for which don't need treated water? (e.g. should we use greywater instead of treated water for watering plants?).
- Hand out a copy of 5:3a. Ask students to record the appearance and appropriate uses of each type of water.
- Compare and discuss answers. Discuss appropriate uses of each type of water. Share examples.

Reflection questions

- What do we mean by pressure on the water supply? *(see teacher notes).*
- How much less water could we use from the water supply by re-using untreated water or greywater for some activities where we currently use tap water? *Answers will vary.*
- Why can't we re-use wastewater? *(see teacher notes).*
- Why don't we use more rainwater or greywater now? *Answers will vary.*

Vocabulary

- greywater
- wastewater
- untreated
- impurities

Learning intentions

Students will:
Recognise the difference between treated water, untreated water, greywater and wastewater

Describe safe uses for the different types of water

Success criteria

Students can:
Describe the differences between treated water, untreated water, greywater and wastewater

Explain appropriate uses for these different types of water

Resources

5:3a Types of water and their uses

Four clear glasses containing water:

1. Treated water (from the tap/bottled water)

2. Untreated water (from a stream or rainwater tank or other source)

3. Greywater (water that has been used to wash hands or from other washing activity)

4. 'Wastewater'*
(a teaspoon of dirt mixed with tap water to simulate wastewater)

***DO NOT use real wastewater**

5:3a Types of water and their uses

Describe the appearance of each type of water and give examples of the types of activities you could use it for in the table below:

Type of water	Description	Appearance	Quality	Possible use
A: Treated water	Water that has been treated and/or filtered and is safe to drink		Clean, healthy water containing no bacteria, viruses or harmful minerals	
B: Untreated water	Fresh water, such as rainwater, collected from a roof or water from a stream or river. Water that has not been treated and could possibly contain bugs or other impurities		Could be unsafe for drinking	
C: Greywater	Greywater is water that is left after washing clothes, dishes, baths or showers. It may contain bugs that make it unsuitable for drinking but can still be used for things like watering gardens. It is not fresh but not seriously polluted		Probably unhealthy water, not safe to use for drinking	
D: Wastewater	Wastewater from toilets, containing human waste, that cannot be used again and must be treated to remove contaminants before it can go back into the water system		Unhealthy water, definitely not safe to use for drinking, probably contains waste	

5:3a Types of water and their uses – answer sheet

Type of water	Description	Appearance	Quality	Possible use
A: Treated water	Water that has been treated and/or filtered and is safe to drink	Clear, no colour or impurities	Clean, healthy water containing no bacteria, viruses or harmful minerals	Drinking, washing the dishes, cooking, showering/ bathing, washing hands
B: Untreated water	Fresh water, such as rainwater, collected from a roof or water from a stream or river. Water that has not been treated and could possibly contain bugs or other impurities	May be clear or slightly coloured. May have impurities	Could be unsafe for drinking	Washing clothes, cleaning, filling the pool, drinking (after being boiled)
C: Greywater	Greywater is water that is left after washing clothes, dishes, baths or showers. It may contain bugs that make it unsuitable for drinking but can still be used for things like watering gardens. It is not fresh but not seriously polluted	May be grey in colour or cloudy. Likely to have some impurities	Probably unhealthy water, not safe to use for drinking	Flushing toilets, watering the garden, cleaning the car
D: Wastewater	Wastewater from toilets, containing human waste, that cannot be used again and must be treated to remove contaminants before it can go back into the water system	Dark or dirty in appearance, will contain impurities	Unhealthy water, definitely not safe to use for drinking, probably contains waste	No suitable use. Should be put into sewage system for treatment

5:4 No water supply for a day – teacher notes

Background knowledge

Water supply issues

We can easily take our water supply for granted. Because the water supply network is so complex and widespread, it is vulnerable to a variety of potential problems. A natural disaster of any kind or a severe weather event can disrupt water services.

Be prepared before a disaster

After a natural disaster demand for help from agencies like the Civil Defence will be overwhelming. Therefore, it is up to individual households to prepare for the possibility that they may not have water or food available for several days. It may even take several weeks or months to restore water to all homes. It is important that everyone prepares for this possibility. Students should consider how their families would be prepared for a disaster. They should ideally have a family emergency plant and an emergency kit including food and water.

Emergency water supplies

Schools are required to have at least 4 litres of water on hand per person per day when a public supply is not available. Homes should have enough emergency water stored for at least 3 litres of water per person for at least 3 days. This amount is just for drinking. More water should be stored for cooking and personal hygiene. Stored water should be replaced every year.

What should we do during an earthquake?

In an earthquake, it is advised to take no more than a few steps and drop, cover, and hold. It is recommended that students shelter underneath a strong table or beside an interior wall.

More information about emergency preparedness is available at:

http://www.whatstheplanstan.govt.nz/earthquake.html

http://www.getthru.govt.nz/

Curriculum links

Health: Level 3
Personal Health and Physical Development
Safety management
Identify risks and their causes and describe safe practices to manage these

Social Sciences: Level 4
Understand how people participate individually and collectively in response to community challenges

Other curriculum links:
L 3 and 4
Social Sciences

Education for sustainability concepts

Sustainability/Hauora:
Everything and everyone in our world is connected

Sustainability/Hauora:
The choices we make today affect the choices we can make in the future

5:4 No water supply for a day – learning experience

Learning experience

- Share the learning intentions and success criteria.
- Explain to students that they are about to hear a fictional scenario about an earthquake. The earthquake has not really happened. It is only a scenario to help them learn about how to prepare for the possibility of a natural disaster.
- Read the fictional news report and earthquake scenario on 5:4a to the students. Clarify the scenario and answer any questions.
- Discuss what an earthquake is. What should students do during an earthquake? See: http://www.whatstheplanstan.govt.nz/earthquake.html
- Explain to students that they will be responsible for organising how the emergency water supplies are used in their homes. If you have emergency water bottles, display these for effect. (In a real emergency, students would be picked up from school where possible).
- Share the other information on 5:4a. Discuss how much water is required for each activity and share ideas about how they would use the 6 litres a day per person.
- Together with the students, decide which water uses would be the highest priority during an emergency situation and which would be the lowest priority.
- Reassure students that there has not been an earthquake and that they are safe.
- Now that you have explored the possibility that one day there may be a natural disaster, investigate how prepared people are at school and at home for the possibility of such an event.
- Ask school staff and the principal whether there are emergency water supplies at the school. Discuss findings.
- Ask students if they are prepared for a natural disaster at home. Explain that they should have water and food stored at home in case of emergency and a family plan for emergency situations. As an extension, students could design an emergency survival plan for home or school.
- Discuss and explore scenarios for other natural disasters with your students like a volcanic eruption, a tsunami, a severe storm, flooding etc. Ask them to think about if they would need to act any differently and would they need different things in the home and in the emergency plan?

Learning intentions

Students will:
Understand the possible effects of an earthquake on the water supply network

Plan the use of emergency water supplies during a natural disaster

Success criteria

Students can:
Describe how the water supply network may be affected by an earthquake or other natural disaster

Plan how they will use a limited supply of water during an emergency situation

Resources

5:4a Earthquake scenario

Emergency water bottles

Reflection questions

- How could we clean ourselves if there is very little water?
  We would need to clean ourselves with a flannel and a small amount of water.
- How could the water supply be affected during an earthquake?
  Shaking and movement of the ground may cause pipes to break.

Vocabulary

- scenario
- fictional
- emergency
- disaster
- disrupted
- damage
- earthquake
- aftershocks

5:4a Earthquake scenario

Fictional news report

At 9:15am this morning an earthquake struck the Region. It measured 7.3 on the Richter scale and could be felt far across New Zealand. During the earthquake the ground was shaking for 50 seconds. It was followed by several aftershocks and more aftershocks are expected in the next few days.

Along the faultline the ground rose up several metres. The enormous ground movements caused damage to buildings, pipes and cables. Some buildings have had walls fall down and several roads have been damaged.

Police have said there is also damage to power lines, stormwater pipes and sewer lines. Some water supply pipes have also been disrupted. Because sewer lines and water pipes have ruptures there is a chance that the water supply might be polluted with waste from the wastewater system.

Major damage has been caused to water supply lines from the water collection areas. These events have interfered with the water supply to most areas.

Residents are asked to not use the water supply until the pipes can be repaired. This may take up to a week. Water will be available from Civil Defence staff very shortly but in the meantime we ask that you use any emergency supplies of water that you have available.

Earthquake scenario

Scenario

Imagine that you have several containers of water stored for emergency situations at home. You have enough for 6 litres of water per person in your family for three days

1. How would you use water differently in an emergency?
2. What would be a high priority for water use? What would be a low priority?
   List the activities you would use water for and rank them in order of importance. Use the chart below for ideas.

Water use	Amount of water used (litres)	Notes
Flushing toilet	6L full flush	Because sewage pipes may be damaged this should be done only when absolutely necessary
Using taps	10L per minute	
Washing dishes (by hand)	6L	
Drinking water	At least 3L per person per day	
Shower	15L per minute	A bath uses about 90L
Garden hose	15L per minute	
Washing machine	100L per load	
Cooking	About 1.5L per pot	

3. How could you adapt some of the water uses above so that you would use less water?

Water treatment

SECTION 6

This section examines the water treatment process inside a water treatment plant. A key part of this section is a visit to a local water treatment plant.

Section 6: Water treatment

PURPOSE

The purpose of this section is to help students to:

- Understand the basic sequence of the water treatment process.
- Explore reasons for water treatment.

Overarching concepts for Section Six:

- It takes time, energy and resources to treat water and make it suitable for drinking.

Learning experiences	Learning intentions Students will:	Curriculum links (Achievement objectives)	Content
1. Keeping our drinking water clean	• Identify appropriate sources of drinking water	**Health: Level 3** **Personal Health and Physical Development** *Safety management* Identify risks and their causes and describe safe practices to manage these **Health: Level 4** **Personal Health and Physical Development** *Safety management* Access and use information to make and action safe choices in a range of contexts	Students identify clean sources of drinking water and explore their local water collection area
2. What happens at the water treatment plant	• Investigate the sequence of events in the water treatment process • Determine the function of water treatment equipment	**Technology: Level 3** **Nature of Technology:** *Characteristics of technological outcomes* Understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures	Students investigate the water treatment process. They place cards describing parts of the process in the correct order on a flow chart
3. Safety at the water treatment plant	• Identify ways to manage hazards at the water treatment plant • Create a safety action plan for their visit	**Health: Level 3** **Personal Health and Physical Development** *Safety management* Identify risks and their causes and describe safe practices to manage these **Health: Level 4** **Personal Health and Physical Development** *Safety management* Access and use information to make and action safe choices in a range of contexts	Students discuss ways to manage possible hazards during their visit and collectively create a safety action plan
4. Visiting a local water treatment plant	• Ask questions to gain further knowledge about the water treatment process	**Science: Level 3 and 4** **Nature of Science** *Investigating in science* Build on prior experiences, working together to share and examine their own and others' knowledge Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations	Visit to the water treatment plant to see the water treatment process first hand. By participating and questioning students gain an in-depth understanding of the water treatment process

6:1 Keeping our drinking water clean – teacher notes

Background knowledge

Collecting the cleanest water

In the Wanganui urban water supply, water is collected from deep bores where the source is as clean as possible to start with (the Nukumaru Aquifer). Providing high-quality drinking water from the water treatment plant is much easier and cheaper if the water to be treated is relatively clean. We remove impurities and microorganisms in the water at a water treatment plant.

Why collect the water from a bore

Water collected from a deep bore is not effected by external factors such as volcanic eruptions or atmospheric pollutants.

What is an aquifer?

An aquifer is an underground layer of gravels or soil which holds water. Water is usually moving very slowly through an aquifer, being filtered along the way.

An aquifer behaves like an underground sponge. Most places on Earth have some form of aquifer underneath them, but because we can't see them, many of us are unaware of their existence.

Water from aquifers

Aquifers naturally filter water wile it is underground and typically water that has been underground for more than one year is free from problems. 100% of the drinking water supplied for the Wanganui urban network is from an aquifer.

Curriculum links

Health: Level 3 and 4
Personal Health and Physical Development
Safety management
Identify risks and their causes and describe safe practices to manage these. Access and use information to make and action safe choices in a range of contexts

Other curriculum links: Level 3 and 4
Science: Nature of Science

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

6:1 Keeping our drinking water clean – learning experience

Learning experience

- Share learning intentions and success criteria.
- Ask students where they would collect drinking water if there was no town supply available to your school or home. Examples include: drinking fountains in the city; streams high in the catchment; catching rainwater.
- Explain that water in the environment can contain germs/impurities which can make it dangerous to drink. A water treatment plant treats the water and removes impurities from it. Treated water is safe to drink.
- Display the poster 'Water sources'. Point out the aquifer, rivers and the sea on the diagram. Read out the teacher notes about water from aquifers.
- Discuss options for obtaining clean drinking water from the environment pictured on the diagram. Ask students to identify several sources of clean drinking water from the poster. List advantages and disadvantages of taking water from each source: e.g. mountain streams, bush streams, city streams, aquifers etc. Discuss which source would be preferable.
- Explain that water is taken for Wanganui's urban water supply from an underground aquifer. The Nukumaru Aquifer provides 100% of the water supply with 65% supplied from the Kai Iwi Wells, 20% supplied from the Heloise Bore and 15% supplied from the Aramoho Bore.
- Brainstorm questions about water treatment. Record questions to ask during a water treatment plant visit.

As an extension, students could research water borne diseases such as giardia. See: http://www.healthed.govt.nz/uploads/docs/HE213.pdf

Learning intentions

Students will:
Identify appropriate sources of safe drinking water

Success criteria

Students can:
Identify appropriate places to source safe drinking water

Resources

Poster: Water sources

Reflection questions

- What could happen if you drank water containing impurities or germs?
  You could become very sick.
- What other methods could we use to treat water from an untreated source before drinking it?
  Water purification tablets, boiling (for at least 3 minutes). These methods can kill germs in water such as giardia.

Vocabulary

- impurities
- purification
- giardia

6:2 What happens at the water treatment plant – teacher notes

Background knowledge

Water treatment – the process

For the Wanganui urban water supply, water is collected from a natural source – the Nukumaru Aquifer. Water collected from the Kai Iwi Wells and Heloise Bore gets treated at the Westmere reservoirs. Water collected from the Aramoho Bore gets treated at the Aramoho Bore site before being distributed throughout the network.

Curriculum links

Health: Level 3 and 4
Personal Health and Physical Development
Safety management
Identify risks and their causes and describe safe practices to manage these. Access and use information to make and action safe choices in a range of contexts

Other curriculum links: Level 3 and 4
Science: Nature of Science

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

6:2 What happens at the water treatment plant – learning experience

Learning experience

- Share learning intentions and success criteria.
- Ask students why we need to treat water before drinking it. There could be impurities in the water that can make us unwell.
- Explain that we will investigate what is used in a water treatment plant and the sequence of events that is undertaken to treat water to a drinking-quality standard.
- Read aloud the teacher notes about the water treatment process. Ask students to listen carefully as they will need some of the information in order to complete the activity.
- Hand out 6:2a. Discuss any new vocabulary and clarify meaning.

As an extension, students could create a flowchart to describe the process of water treatment.

Learning intentions

Students will:
Investigate the sequence of events in the water treatment process

Determine the function of water treatment equipment

Success criteria

Students can:
Order the sequence of events in the water treatment process

Explain the function of water treatment plant equipment

Resources

6:2a The water treatment process

Reflection questions

- Why do you think the water has to be as clean as possible before the water treatment process starts?
  It takes less effort and resources to treat water to drinking-quality standards if water is relatively clean to start with.

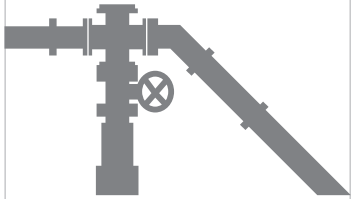
- How do staff make sure that all impurities have been removed?
  Water is thoroughly tested along the way before being distributed.

- What might happen if we didn't store water in reservoirs?
  We may not have enough water to satisfy all demands for water. Demand for water fluctuates not only depending on the time of year but also the time of day. Without having water stored for immediate supply and use there would not be enough during peak demand periods.

Vocabulary

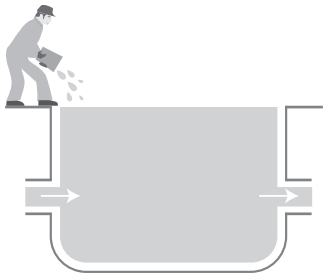
- chlorine

6:2a The water treatment process



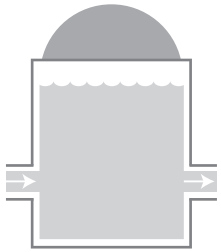
1. Collecting

We pump water up to the surface from a deep underground aquifer – the Nukumaru Aquifer. This water only needs minimal treatment to be drinkable.



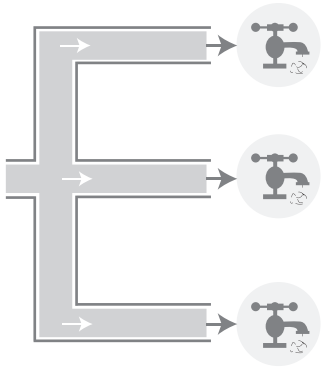
2. Treatment

We add chlorine to the water to kill any bugs that might get into the pipes or the reservoirs while water is on its long journey to our taps.



3. Storing

Storing water in reservoirs and water towers means an immediate supply of water is available even during peak demand periods.



4. Distributing

Treated water can now make its journey to your taps.

6:3 Safety at the water treatment plant – teacher notes

Background knowledge

Hazards

A hazard is a possible danger. A hazard can be a situation which may lead to an injury or pose a threat to a person.

Why do a safety plan with my students?

This activity is designed to involve students in making a safety plan for the visit to the water treatment plant. If students complete this activity before the visit, they will be more aware of potential hazards at the water treatment plant.

They will have more ownership and therefore more buy-in for following a safety plan if they have had a part in creating it.

Will this be the only safety preparation I need to do for the visit?

No. Your school will have its own health and safety plans and regulations for trips. However, completing this activity with your students will make completing your school safety assessments e.g. risk analysis matrices/hazard management plans much easier.

Hazard management process

(Taken from the Dept of Labour website)

1. Identify hazards
2. Assess if significant
3. If yes,

1. *Eliminate*, if practicable
2. Isolate, if not practicable to eliminate
   - inform people involved
   - monitor to ensure controls are effective
3. *Minimise,* if hazard cannot be isolated
   - inform employees of controls
   - provide, make accessible, and ensure the use of protective clothing and equipment
   - monitor to ensure controls are effective

See *http://www.dol.govt.nz/publications/big6/hazard-management-processimg.asp* for more information

NB: Teachers need to complete 6:3b Visitor information and 6:4a Group visitor induction on behalf of their students and give to water treatment plant staff on the day of their visit.

Curriculum links

Health: Level 3 and 4
Personal Health and Physical Development
Safety management
Identify risks and their causes and describe safe practices to manage these. Access and use information to make and action safe choices in a range of contexts

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

6:3 Safety at the water treatment plant – learning experience

Learning experience

- Share the learning intentions and success criteria.
- Ask students if they understand what a hazard is.
- Explain the need for a safety action plan.
- Brainstorm what risks/hazards there might be at a water treatment plant.
- Decide on several ways to prevent the hazards discussed from being a problem during the visit.
- Discuss what would happen if there was an emergency situation at the water treatment plant. *It may be necessary to call an ambulance, may need to leave/ evacuate.*
- Go over health and safety expectations for the day. Discuss the location of your first aid kit and procedures for what students should do if a hazardous situation occurs.
- How will students be expected to behave on the day of the visit? How could behaviour affect safety during the visit? *E.g. behaving sensibly and not touching equipment.*
- Ask students to complete 6:3a. Explain that they must think of ways to prevent hazards from occurring and explore how to deal with problems if they do occur. The 'when/where' column applies to when and where the *preventative* actions should be taken.
- Share answers and decide on the best answer for each part of the safety plan. Create a shared safety action plan as a result.
- Reassure students that staff at the water treatment plant are trained to deal with hazards and emergency situations at the plant and will give assistance throughout your visit.

Learning intentions

Students will:
Identify ways to manage hazards at the water treatment plant

Create a safety plan for their visit

Success criteria

Students can:
Describe ways to prevent hazards from occurring

Contribute to writing a safety action plan

Resources

6:3a Safety action plan for water treatment plant visit

6:3b Visitor information

Reflection questions

- Is there anything else we could do to keep ourselves safe at the treatment plant?
  Answers will vary.

Vocabulary

- impurities
- purification

6:3a Safety action plan for water treatment plant visit – teacher notes

Possible risk	Cause of risk	Responsibility	Preventative actions	When/where	Emergency plan
Plant emergency	Various	Plant staff	Regular checks and maintenance	Every day at various locations within plant	Plant staff deal with emergency as required
Contact with dangerous chemicals	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Electric shock	Uncontrolled access to electrical cabinets	Supervising teacher, students, parents/helpers			
General fall	Running, not paying attention	Students, supervising teacher, parents/helpers			
Lost students	Poor supervision, not paying attention	Students, supervising teacher, parents/helpers			
Medical problems resulting from an existing condition such as an allergy	Trigger, such as insect bite Asthma attack	Supervising teacher, parents/helpers, students			
Accident with vehicle in the car park	Poor supervision	Supervising teacher, parents/helpers, students			

6:3a Safety action plan for water treatment plant visit – possible answers

Possible risk	Cause of risk	Responsibility	Preventative actions	When/ where	Emergency plan
Contact with dangerous chemicals	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers; buddy system, supervision by parents/teachers	Before visit, at start of plant tour	Alert plant staff Apply appropriate first aid
Electric shock	Uncontrolled access to electrical cabinets	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers; buddy system, supervision by parents/teachers	Before visit, at start of plant tour	Call an ambulance (if needed)
General fall	Running, not paying attention	Students, supervising teacher, parents/ helpers	Instruct students to stay calm and with the group at all times	Before visit, at start of plant tour	Apply appropriate first aid
Plant emergency	Various	Plant staff	Internal systems	At start of plant tour	Evacuate to area outside main entrance; roll call
Lost students	Poor supervision, not paying attention	Students, supervising teacher, parents/ helpers	Buddy system, supervision; agree on a regrouping area and a time and make sure everyone knows how to get to that area	Before visit, at start of plant tour	Alert plant staff Contact parents Call police to report missing
Medical problems resulting from an existing condition such as an allergy	Trigger, such as insect bite Asthma attack	Supervising teacher, parents/ helpers, students	Ensure necessary medication accompanies the student on thevisit; make accompanying parents/helpers aware of any health conditions; buddy system	Before visit	Apply appropriate first aid Call an ambulance (if needed) Contact parents Inform plant manager
Accident with vehicle in the car park	Poor supervision	Supervising teacher, parents/ helpers, students	Have safe area in carpark to go into and out of bus. Supervise students on way to and from water treatment plant	On the way to or on arrival at plant	Apply appropriate first aid/Call an ambulance (if needed)

6:3b Visitor information

Welcome to the Wanganui Water Treatment Plant

The following information is important for your safety
It is a requirement of entry to this facility that you read the following information. All visitors must sign this sheet to confirm that they have read and understand this information.
Please Note: This sheet must be left at the plant upon departure.

Hazards - The main hazards on site are:

- Corrosive and toxic chemicals

Corrosive and toxic chemicals

The following chemicals are stored and used on this site. Ask a staff member if you are unsure of the location of the chemicals.

Chemical	Hazard Health	Effects
Chlorine Gas	Poisonous and Highly Corrosive	Asphyxiation/Pulmonary Oedema

Open water surfaces

Hand rails and barriers are installed around all open water surfaces. Please **do not lean on or climb over any railing or barrier** that is provided for your protection.

In the event of an emergency make your way quickly to the evacuation area. Speak with a staff member if you are unsure of the location of the evacuation area when on site.

I have read and understood the above information and agree to act in a responsible manner during my visit, and in accordance with the advice contained in this induction handout.

Name: _____ Organisation: _____

Signature: _____ Date: _____

6:4 Visiting the Water Treatment Plant – teacher notes

Background knowledge

Organisation for the visit

Before your visit, make sure you and your students are well prepared for the day. Visit the location to familiarise yourself with the area.

Contact Wanganui District Council to organize a date and time to visit the water treatment plant: ph. (06) 349 0001 or email. wdc@wanganui.govt.nz

A suggested itinerary is included – see 6:4a Visit schedule example. This is only an example. Discuss a schedule with your council staff.

Visiting the Treatment Plant and Wells

As part of the trip you may wish to also visit the Kai Iwi Wells. This is recommended as a whole unit visit to see where the water is pumped from the ground through to the storage of the water before distribution. It will enhance understanding of the whole process and how it relates to the surrounding environment.

What can I do, as a teacher, to maximise learning during our visit?

Preparing students well for the visit will encourage excitement about it. Having some prior knowledge of the water treatment process will increase student interest and understanding. Students should have some prepared questions to ask staff. You may want to also give individual students responsibility for aspects of the visit. This will also encourage full attention and engagement.

Curriculum links

Science: Level 3 and 4
Nature of Science
Investigating in science
Build on prior experiences, working together to share and examine their own and other's knowledge. Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations

Education for sustainability concepts

Responsibility for Action/Kaitiakitanga:
If we want to use taonga, we must look after the taonga. Taking action, informed decision-making, citizenship, consumerism, enterprise, resilience and regeneration

What to take:

Students:
- Sensible walking shoes
- A warm jacket/rain jacket
- Sunblock and a hat
- Digital cameras (if possible)
- Prepared questions for the staff at the water treatment plant (ideally email these prior to the visit)
- Pen and notebook
- Food and drink

Teacher:
- 6:3b Visitor information (completed) to give to guide
- 6:4a Group visitor induction (completed) to give to guide
- A list of students and adults present at visit to give to the guide
- Health and safety documentation
- First aid kit

6:4 Visiting the Water Treatment Plant – learning experience

Learning experience

6:4a Visit schedule example summarises an example visit to the Wanganui Kai Iwi Wells and Water Treatment Plant/Westmere Reservoirs. Prepare yourself for the visit by being aware and understanding who holds responsibilities (council worker/teachers/students).

Prior to your visit, ensure that you have sent a notice home to parents, detailing what students need to bring. See 'what to take' below. Discuss your expectation of students before the visit.

The maximum group size is 20 students and the minimum age allowed is 7 years. The ratio of adults to students should be at least 1:6 for children aged between 7-9 years and 1:12 for children aged between 10-15 years.

Approximate travel time from Wanganui to the Kai Iwi Wells: 25 - 30 minutes. Approximate travel time from the Kai Iwi Wells to the treatment plant and Westmere Reservoirs: 15 - 20 minutes.

Learning intentions

Students will:
Ask questions to gain further knowledge about the water treatment process

Success criteria

Students can:
Ask appropriate questions to plant staff about water treatment

Resources

6:3b Visitor information

6:4a Group visitor induction

6:4a Visit schedule: Water Treatment Plant (guided)

Timeframes	What happens at each point:		
	What do the guides do?	What do the students do?	What does the teacher do?
At Kai Iwi Wells			
Meet the guide *10 mins*	Introduce themselves Explain what their job involves Give health and safety talk	Listen	Supervise students
Viewing the wells *20 mins*	Ask students what they already know about how water gets to the taps Allow opportunities for several questions	Listen Answer questions Share their knowledge	Encourage students Supervise students
At Westmere Reservoir and Treatment Plant			
Viewing the water treatment process *30 mins*	Ask students what they already know about the water treatment process Encourage critical thinking Allow opportunities for several questions	Listen Answer questions Share their knowledge	Circulate and help students Encourage students Supervise students

6:4a Group visitor induction

Understanding of Responsibility: Visiting Groups

As part of our health and safety programme, we require that all visitors to Wanganui District Council facilities sign in upon arrival and out upon departure. Signing in is an acknowledgement that visitors have been made aware of our Visitor Induction details before entering the plant.

To speed the arrival and departure process for visiting groups, we ask that the teacher or group leader sign in on the day, on behalf of the whole group. This will signify acceptance of responsibility for ensuring that all members of the group have had the induction information explained to them. The teacher or adult who has prime responsibility for the visiting group must also sign the following declaration on the day of the visit.

Declaration

I have read and understood the Visitor Induction information on **6:3b Visitor information**, and have conveyed this information to the group members who will be present for our visit. I agree to take responsibility for the members of my group acting in a responsible manner during our visit, in accordance with the advice contained in the induction handout.

Name: _____

Group/School: _____

Date: _____

Total number of visitors: Children: _____ Adults: _____

Signature: _____

* Please bring with you, attached to this form, a list of the names of all children and adults who are included in your group, ensuring that it is accurate on the day of the visit. This will help us to account for your group members quickly in the unlikely event of an emergency occurring while you are on site.