

SECTION FOUR:

Water treatment — Te Marua or Wainuiomata

This section examines the water treatment process inside a water treatment plant.

A key part of this section is a visit to one of the Greater Wellington's water treatment plants (Te Marua or Wainuiomata)

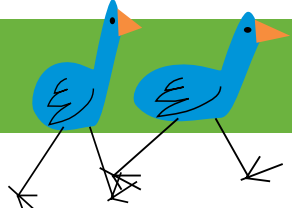
Section Four is divided into two versions: Te Marua and Wainuiomata. You will need to decide on which water treatment plant you wish to visit before proceeding with this section. If you are visiting the Te Marua Water Treatment Plant then you need to use the Te Marua version of this section (pages 65 – 88). If you are visiting the Wainuiomata Water Treatment Plant then you need to use the Wainuiomata version of this section (pages 89 – 112).

We recommend booking your tour before you reach this section to ensure that your chosen water treatment plant is able to accommodate your visit.

To organise a date and time to visit the water treatment plant, contact our staff:

ph: (04) 384 5708 or email: info@gw.govt.nz





Section 4: Water treatment

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 Four:

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

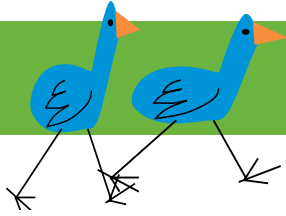
Section 4: Water treatment – Te Marua



Learning experiences – Section Four

Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
1. Keeping our drinking water clean	<ul style="list-style-type: none"> Identify appropriate sources of drinking water 	Health: Level 3 and 4: Personal Health and Physical Development: <i>Safety management</i> Identify risks and their causes and describe safe practices to manage these	Students identify clean sources of drinking water and explore the Hutt Water Collection Area
2. What happens at the water treatment plant	<ul style="list-style-type: none"> Investigate the sequence of events in the water treatment process Determine the function of water treatment equipment 	Technology: Level 3: Nature of Technology: <i>Characteristics of technological outcomes:</i> 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 treatment process in the correct order on a flow chart
3. Safety at the water treatment plant	<ul style="list-style-type: none"> Identify ways to manage hazards at the water treatment plant Create a safety action plan for their visit 	Health: Level 3 and 4: Personal Health and Physical Development: <i>Safety management</i> Identify risks and their causes and describe safe practices to manage these	Students discuss ways to manage possible hazards during their visit and collectively create a safety action plan
4. Visiting the Te Marua Water Treatment Plant	<ul style="list-style-type: none"> Ask questions to gain further knowledge about the water treatment process 	Science: Level 3 and 4: Nature of Science <i>Investigating in science</i> <ul style="list-style-type: none"> 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
5. Experiment: Clumping with coagulants	<ul style="list-style-type: none"> Observe changes to different types of water when a coagulant is added to it 	Science: Level 3 and 4: Material world: <i>Chemistry and society:</i> Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes	*This experiment will be conducted by staff at the water treatment plant Students observe and describe changes to different samples of water when a coagulant is added

4:1 Keeping our drinking water clean – teacher notes



Curriculum links

Health: Level 3 and 4
Personal Health and Physical Development: Level 3:

Safety management:
 Identify risks and their causes and describe safe practices to manage these

Level 4:
Safety management:
 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:*
 Investigating in science

Background knowledge

Collecting the cleanest water

In Wellington, water is collected from rivers where the source is as clean as possible to start with (the Hutt, Orongorongo and Wainuiomata rivers). 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 in the water at a water treatment plant.

Why collect the water at Kaitoke?

Water that is treated at Te Marua Water Treatment Plant comes from Kaitoke. When rain falls in the Tararua Ranges, water that is not absorbed into the ground starts to run downhill towards the sea through the streams of the bush-clad Hutt Water Collection Area. These streams feed into the Hutt River above Kaitoke (just north of Upper Hutt). They run through a large area of native forest, which is an ideal environment for keeping water as clean as possible.

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 while it is underground and typically water that has been underground for more than one year is free from problems. In Wellington, some 40% of our drinking water is from the Waiwhetu Aquifer. Water from the Waiwhetu Aquifer has been underground for more than a year, so the water that comes out of it doesn't need to be treated to be safe to drink.

Kaitoke Weir

A weir is a small dam. It raises the water level in one part of the river to help divert water into an intake chamber. While most of the water flows on down the river, some flows into the intake chamber and through a tunnel in the hillside to the strainer house for screening.

The area above the Kaitoke Weir is called the Hutt Water Collection Area which is managed to reduce the risk of the water becoming polluted. Possible pollutants could include: animal and human waste, soil, rubbish, chemicals, oil and petrol. To manage this risk, grazing stock and vehicles are kept out of the water collection area above the weir, and although people can walk in nearby areas, they are not allowed to camp in those places overnight.



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

4:1 Keeping our drinking water clean – learning experience



Learning experience

- Share the learning intention and success criteria
- Ask students where they would collect drinking water if there was no town supply available. *Examples include: drinking fountain at Petone, 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 'Greater Wellington's 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 Wellington's water supply from the Hutt Water Collection Area, the Wainuiomata/Orongorongo Water Collection Area and from the Waiwhetu Aquifer. *The Hutt Water Collection Area and the Waiwhetu Aquifer each provide about 40% of Wellington's supply. The remaining 20% of the water supply is taken from the Wainuiomata/Orongorongo Water Collection Area*
- Brainstorm questions about water treatment. Record questions to ask during the water treatment plant visit. *For more information see: <http://www.gw.govt.nz/sources-of-water/>*

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

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

Learning intention



Students will:

Identify appropriate sources of safe drinking water

Success criteria



Students can:

Identify appropriate places to source safe drinking water

Resources



Poster Greater Wellington's water sources



4:2 What happens at the water treatment plant – teacher notes



Curriculum links



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

Other curriculum links at Level 4:

Health: *Movement concepts and motor skills: Science and Technology:*

Experience and demonstrate how science, technology and the environment influence the selection and use of equipment in a variety of settings

Background knowledge

Water treatment – the process

Before the water treatment plant

Water is collected from a natural source. For the Te Marua Water Treatment Plant, water is collected at the Kaitoke Weir.

Screening the water

The water that has been collected must be screened to remove any debris. At the **strainer house**, water passes through rotating **screens** that are finer than a flour sieve (*250 holes per square centimetre*). Big items, such as, grit, sand, gravel, rocks, sticks and leaves, are flushed back into the river. Small fish can swim into the intake chamber but they usually swim out again and don't travel as far as the strainer house. If they do reach the strainer house they are flushed back into the river. Large fish are prevented from entering the intake chamber by a large grid that you can see when you visit the weir.

Although we have collected the water from the cleanest possible source, there will still be impurities in it that are too small to see or catch in the strainer house screens.

Storing water in Stuart Macaskill Lakes

Sometimes, when there hasn't been much rain, the river's water level gets so low that it would not be good for the ecosystem downstream to take as much water as we need for drinking water treatment. But we always need drinking water. So, when the water levels are high, we take out extra water from the river and store it. We store it in the Stuart Macaskill Lakes. You can see these lakes on your left as you drive up the Rimutaka Hill towards the Wairarapa. The lakes can hold enough water to supply the four cities (Lower Hutt, Porirua, Upper Hutt and Wellington) for 21 days. Having this stored water means that when the water levels in the river are too low to take out all the water we need, we can use water from the lakes as well.

This water can also be used if the river water is too dirty to treat (usually after a storm).



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



Inside the water treatment plant

Clumping impurities

Because the impurities floating in the water are very small, it's easier to get them out if we can clump them together in groups. In the **reaction tanks**, we add chemicals like Polyaluminium Chloride (PACl) to the water which attract the suspended particles like a magnet and bind them together into larger particles that we can see (called *floc*). The floc is large enough to sink so that we can separate them more easily from the water.

Separating out the floc to remove impurities

The floc sinks to the bottom of the **settling tanks**. Then they are separated off and sent to a **centrifuge**, which spins really fast, removing the excess water, like the spin cycle in a washing machine, returning the clean water to the inlet of the water treatment plant (a great example of recycling) and leaving behind solid sludge waste. The sludge is sent along a **conveyer belt** and down into a **skip bin** to be taken to the landfill at Silverstream. *(Without fail, the student's favourite part of the water treatment plant visit is watching the sludge plop onto the conveyer belt and then off into the skip.)*

Filtering the water

The water that flows out the top of the **settling tank** goes into the next tank through a set of **sand filters**, which act like very fine screens trapping and separating out any last particles that weren't removed in the **settling tanks**.

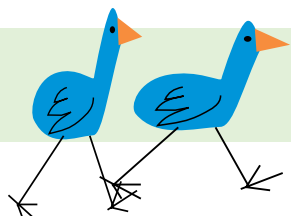
Making sure the water is safe to drink

The clean drinking water is almost ready for our taps. However, it has a long way to go from the water treatment plant, through pipes to local storage **reservoirs** and then through more pipes before it reaches our taps – it might take 2½ days to get from the Te Marua Water Treatment Plant to a reservoir in Wellington city. We add chlorine to the water to kill any bugs that may remain in the water or that might get into the water over the long journey. Fluoride is also added to help keep our teeth strong and healthy.

The water is monitored throughout the treatment process to make sure it meets our country's drinking water standards.

What is a technological outcome?

Technological outcomes are products and systems developed for a specific purpose. A technological outcome is evaluated in terms of its fitness for purpose.



4:2 What happens at the water treatment plant – learning experience

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

BLM 4a The water treatment process: Te Marua

BLM 4b Water treatment process cards: Te Marua

Poster Water treatment process – Te Marua

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 the equipment used in a water treatment plant and the sequence of events that is undertaken to treat water to drinking-quality standards
- Read aloud the teacher notes on pages 68-69 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 BLM 4a and BLM 4b. Discuss any new vocabulary and clarify meaning
- Ask students to cut out cards on BLM 4b. Stick into the correct box under the pictures on BLM 4a. Each card explains a step in the water treatment process
- When students have ordered the cards ask them to compare answers
- Show students the poster 'Water treatment process – Te Marua'. Revise the steps of the water treatment process with the poster as a guide, while students determine if their cards are in the correct order
- Discuss any equipment featured on the poster and cards. Ask what each piece of equipment's function is. *Treatment plant equipment is written in **bold** on the teacher notes pages*

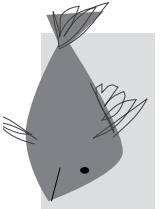
As an extension, students could create a flowchart to describe the process of water treatment.

Reflection questions

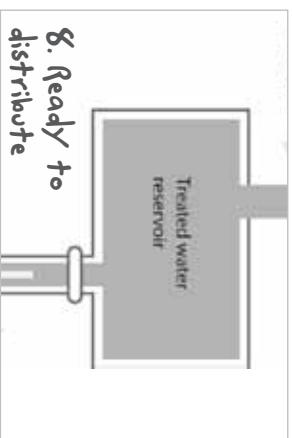
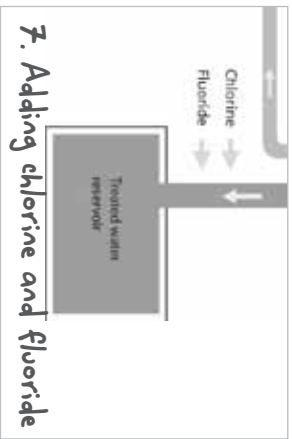
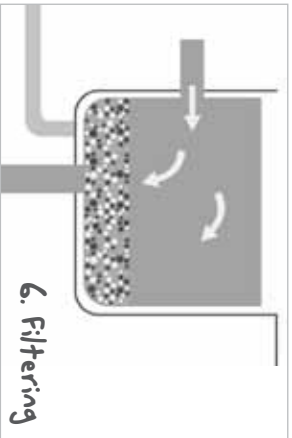
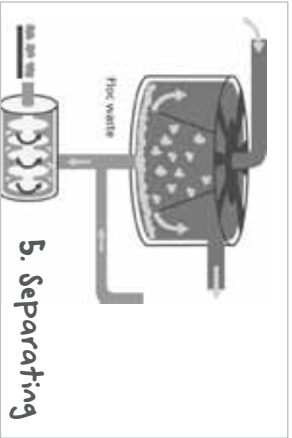
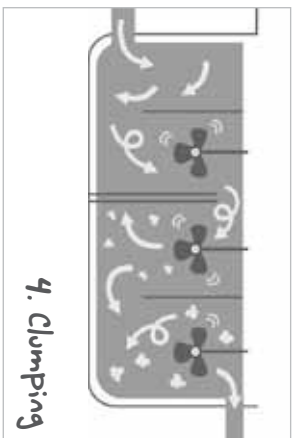
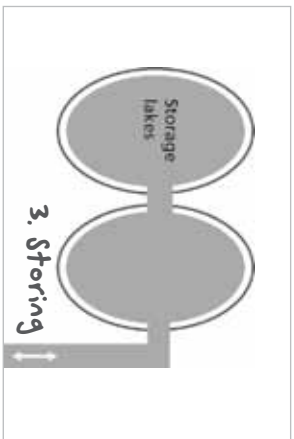
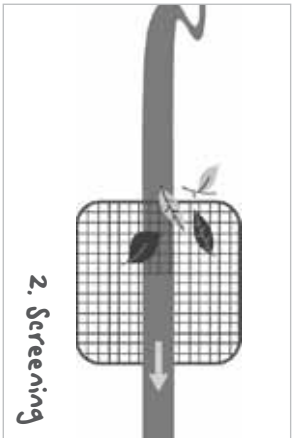
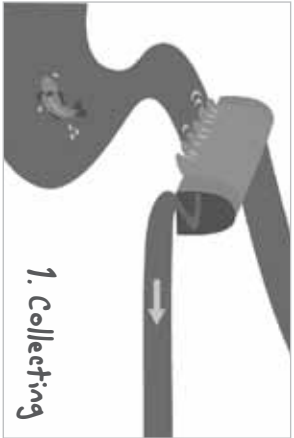
- Why do you think the water has to be as clean as possible before the water treatment process starts? *It takes less effort and resources to treat water to drinking-quality standards if water is relatively clean to start with*
- How do staff make sure that all impurities have been removed? *Water is thoroughly tested along the way before being distributed*
- What might happen if we didn't store water in the Stuart Macaskill Lakes? *We may not have enough water to satisfy all demands for water*

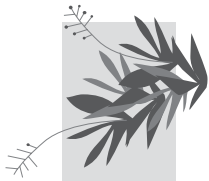
Vocabulary

- screening
- filtering
- floc
- chlorine
- fluoride



BLM 4a: The water treatment process: Te Marua





BLM 4b: Water treatment process cards: Te Marua

Cut out the cards below. Place each card in the appropriate space on BLM 4a to describe the order of the water treatment process.

Water passes through a set of sand filters. These filters act like very fine screens trapping and separating out any last unwanted, small impurities.

Rain falls and collects in streams and rivers in the Hutt Water Collection Area. Some of this water flows into the water supply intake towards the water treatment plant.

The treated water is now ready to be distributed to the community.

The water goes through a fine screen to stop leaves, branches and gravel from getting into the water treatment plant.

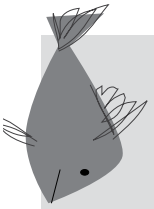
We add chemicals to the water and stir it. This helps all the impurities clump together to make 'floc'. Floc is easier to see and to get out.

The floc sink to the bottom of the settling tank. They are separated from the water to make sludge waste. The sludge is carried away to a skip bin.

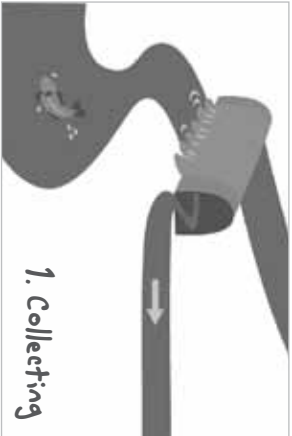
We add chlorine to the water to kill any bugs that might get into the pipes while the water is on its long journey to our taps. Fluoride is also added to help keep our teeth healthy.

Some untreated water is stored at the Stuart Macaskill Lakes for times when we can't take water from the river.

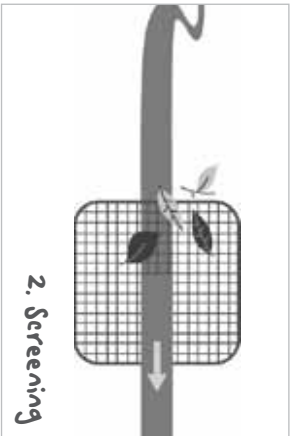




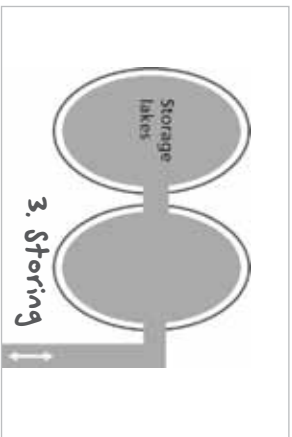
BLM 4b: The water treatment process: Te Marua - Answer sheet



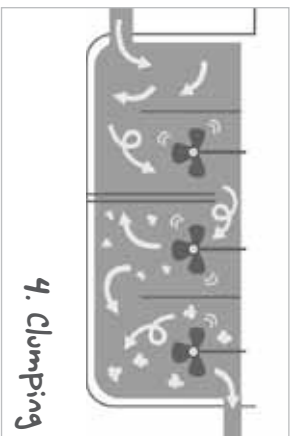
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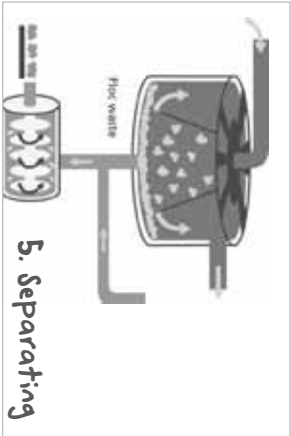
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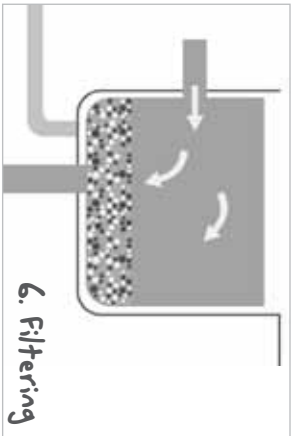
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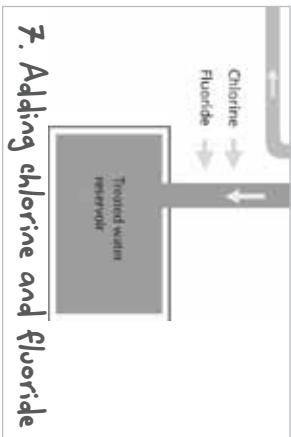
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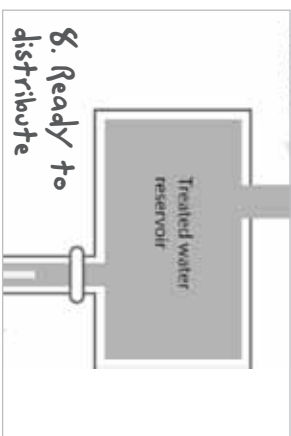
The floc sink to the bottom of the settling tank. They are separated from the water to make sludge waste. The sludge is carried away to a skip bin.



Water passes through a set of sand filters. These filters act like very fine screens trapping and separating out any last unwanted, small impurities.

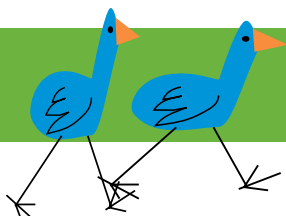


We add chlorine to the water to kill any bugs that might get into the pipes while the water is on its long journey to our taps. Fluoride is also added to help keep our teeth healthy.



The treated water is now ready to be distributed to the community.

4:3 Safety at the water treatment plant – teacher notes



Curriculum links

Health: Level 3 and 4 Personal Health and physical development:

Level 3: *Safety management:*
Identify risks and their causes and describe safe practices to manage these

Level 4: *Safety management:*
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

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 can't 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-process-img.asp> for more information

NB: Teachers need to complete BLM 4d Visitor information and BLM 4e Group visitor induction on behalf of their students and give to water treatment plant staff on the day of their visit.

4:3 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 (*see teacher notes*)
- Explain the need for a safety action plan
- Brainstorm what risks/hazards there might be at a water treatment plant. *Read BLM 4d for examples*
- 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 BLM 4c. 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



BLM 4c Safety action plan for plant visit

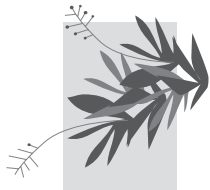
BLM 4d Visitor information: Te Marua

Reflection questions

- Is there anything else we could do to keep ourselves safe at the treatment plant? *Answers will vary*
- How could sludge waste be harmful? *See BLM 4d*

Vocabulary

- impurities
- purification



BLM 4c: Safety action plan for water treatment plant visit

Helping students make informed choices about how they use tap water

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			
Injury from machinery in plant	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Electric shock	Uncontrolled access to electrical cabinets	Supervising teacher, students, parents/helpers			
Fall into open water	Climbing over barrier	Supervising teacher, students, parents/helpers			
General fall	Running, not paying attention	Students, supervising teacher, parents/helpers			
Contact with sludge waste	Uncontrolled access to restricted areas	Supervising teacher, students, 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			



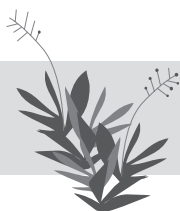
greater WELLINGTON
REGIONAL COUNCIL
Te Pane Matua Taiao



BLM 4c: 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
Injury from machinery in plant	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers, 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)
Fall into open water	Climbing over barrier	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers, supervision by parents/teachers	Before visit, at start of plant tour	Adult to retrieve student Call an ambulance/apply first aid
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
Contact with sludge waste	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	Wash hands immediately
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 the visit; 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)





BLM 4d: Visitor Information

Welcome to the Te Marua 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 and note the emergency provisions on BLM 4f. 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
- Open water surfaces
- Rotating machinery
- Sludge waste

Corrosive and toxic chemicals

The following chemicals are stored and used on this site. The storage location of these chemicals is identified on the site plan (BLM 4f).

Chemical	Hazard	Health Effects
Chlorine Gas	Poisonous and Highly Corrosive	Asphyxiation/Pulmonary Oedema
Carbon Dioxide Gas	Displaces Oxygen	Asphyxiation
Caustic Soda	Highly Corrosive	Severe Burns
Fluoride	Toxic	Poisoning
Aluminium Sulphate	Mildly Corrosive	Minor Burns
Hydrated Lime	Mildly Corrosive	Minor Burns

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.

Rotating machinery

Please be aware that the Treatment Plant is fully automated and therefore machinery could start at any time. All exposed rotating parts have been fitted with guards to prevent accidental contact. **Keep clear of any working machinery and equipment.**

Sludge Waste

Most contaminants, including Viruses, Giardia and Cryptosporidium, are removed from the raw water and concentrated in the sludge waste. **Do not handle this waste.** Wash your hands if accidental contact occurs.

In the event of an emergency make your way quickly to the evacuation area shown on map (BLM 4f)

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: _____

4:4 Visiting the Te Marua 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.

To organise a date and time to visit the water treatment plant, contact our staff; ph: (04) 384 5708 or email: info@gw.govt.nz

A suggested itinerary is included – see *Visit schedule: Te Marua Water Treatment Plant* on pages 82 and 83. You may choose to only visit the water treatment plant.

Visiting Kaitoke Weir and/or the Strainer House before the water treatment plant

On the way to the water treatment plant, you may wish to take the bus to the Waterworks Road end of Kaitoke Regional Park to visit the Kaitoke Weir and the Strainer House. You can walk to the weir from the Pakuratahi Forks carpark in the Kaitoke Regional Park. The weir is a 15 minute walk from the carpark, on a sealed road. The walk to the Strainer House is a one hour return trip. See the map on page 81.

Water is collected for the Te Marua Water Treatment Plant from the Kaitoke Weir. Going to the weir is well worth the effort, as students will get to see where the water starts the treatment process. This will enhance understanding of the treatment process and how it relates to the surrounding environment.

If you decide to visit the Kaitoke Weir, we recommend that you contact the Kaitoke Regional Park Ranger on 04 526 7322 to check that the weir walk is open.

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:

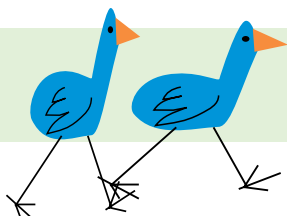
Build on prior experiences, working together to share and examine their own and other's knowledge

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
- Sunblock and a hat
- **BLM 4g** Coagulant experiment notes, 1 copy between 2
- Digital cameras (if possible)
- Prepared questions for the staff at the water treatment plant (*ideally email these prior to the visit*)
- Pen and something firm to press on
- Food and drink

Teachers:

- **BLM 4d** Visitor information (*completed*) to give to guide
- **BLM 4e** Group visitor induction (*completed*) to give to guide
- **BLM 4f** Map of Te Marua Water Treatment Plant
- A list of students and adults present at visit to give to the guide
- Health and safety documentation
- First aid kit

Stuart Macaskill lakes lookout

Visiting the Stuart Macaskill lakes lookout is optional. The lookout is located just outside the gates of the Te Marua Water Treatment Plant. It consists of picnic tables and seats built out of water supply infrastructure along with information about the lakes. It is also a handy location for your class to have a morning tea or lunch break.

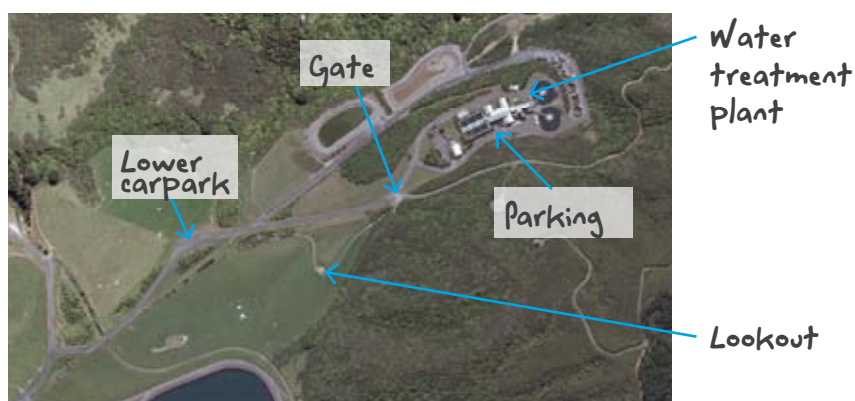
There will be no guide with you at the lakes lookout.

Below is a suggested learning sequence to take students through while at the lookout point. Adapt according to your student's prior knowledge and interests.

Suggested learning experience while at lookout:

1. Walk to the lookout from either the lower carpark (about 5-10 minutes walk), or from the water treatment plant carpark (5 minutes walk).
2. Read 'Why did we build them?' sign aloud to students. Allow questions and answer as best you can. Ask students to remember questions you can't answer to ask staff at the end of the visit.
3. Explain that the viewport pipes above the signs at the lookout are pieces taken from the Te Marua to Wellington water pipeline. These pieces were taken out when shut-off valves were inserted into the pipeline.
4. Read the earthquake interpretation sign aloud. Explain the purpose of the Stuart Macaskill lakes. If time, estimate with students where the Wellington fault lies and line students up on it. Explain that the fault goes through Wellington city, through this area and on to the Bay of Plenty.
5. If there is more time, also discuss the location of the water pipeline (see *map on earthquake sign*). Discuss this location in relation to the faultline.
6. You can either walk back down to the bus or walk up to the water treatment plant. The bus can meet you at the water treatment plant entrance at the end of your tour.

Map of Stuart Macaskill Lookout



4:4 Visiting the Te Marua Water Treatment Plant – learning experience



Learning experience

The visit schedule on pages 82 and 83 summarises the visit to the Te Marua Water Treatment Plant. It outlines the responsibilities of the water treatment plant staff, teachers and students. **Please read it carefully before your scheduled visit.**

Prior to your visit, ensure that you have sent a notice home to parents, detailing what students need to bring (*'what to take' – teacher notes*). Also discuss your expectations of students before the visit.

On the way to the water treatment plant, you may want to also visit the Kaitoke Weir and the Strainer House. This is a worthwhile add-on to a trip. The weir is where the water starts the treatment process and the Strainer House is where leaves, branches and gravel are removed from the water (*see teacher notes*).

The maximum group size is 30 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.

Learning intentions



Students will:

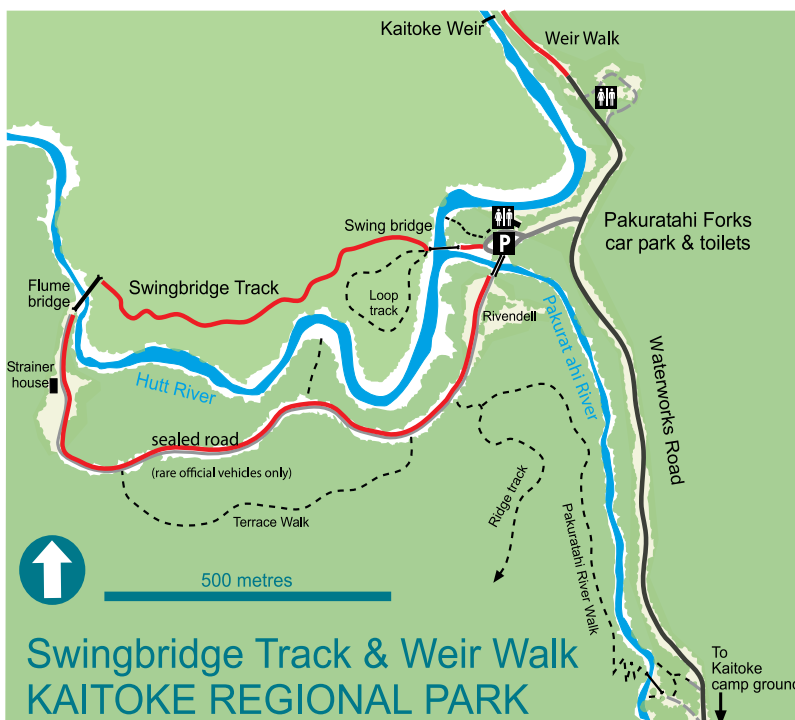
Ask questions to gain further knowledge about the water treatment process

Success criteria



Students can:

Ask appropriate questions to plant staff about water treatment



Resources

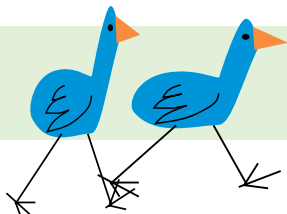


BLM 4d Visitor information: Te Marua

BLM 4e Group visitor induction

BLM 4f Map of Te Marua Water Treatment Plant

BLM 4g Coagulant experiment (for students to complete during experiment)



Visit schedule: Kaitoke Weir and Strainer House *(unguided, optional)*

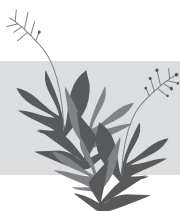
Timeframes	Where	What happens at each point:		
		What do the guides do?	What do the students do?	What does the teacher do?
<i>Before the water treatment plant</i>				
Kaitoke Weir <i>(Optional)</i> 15 minutes	Kaitoke Regional Park	No guides	Examine weir, ask questions	Point out areas of interest including the weir and water collection area. Ask questions, initiate discussion
Strainer House <i>(Optional)</i> One hour for Strainer house walk	Kaitoke Regional Park	No guides	Examine Strainer House, ask questions	Point out areas of interest. Ask questions, initiate discussion

Visit schedule: Te Marua Water Treatment Plant *(guided)*

Activity and Timeframes	Where	What happens at each point:		
		What does the guide do?	What do the students do?	What does the teacher do?
<i>At the water treatment plant</i>				
Meet the guide 10 mins	Front door	<ul style="list-style-type: none"> – Introduce themselves and lead group through to teaching room – Explain what their job involves – Give health and safety talk 	Listen	Supervise students
Introduction 5 mins	Teaching room	<ul style="list-style-type: none"> – Ask students what they already know about why we need to treat water – Show pictures of giardia and cryptosporidium bugs 	Listen, answer questions	Encourage students
Viewing the water treatment process diagram 15 mins	Teaching room	<ul style="list-style-type: none"> – Ask students what they already know about the water treatment process – Add information about each step to extend students' knowledge and understanding. Encourage critical thinking – Allow opportunities for several questions 	Share their knowledge	Circulate and help students



Activity and Timeframes	Where	What happens at each point:		
		What does the guide do?	What do the students do?	What does the teacher do?
<i>At the water treatment plant</i>				
Experiment: Coagulation 10 mins	Teaching room	Set up and discuss coagulant experiment (learning experience 4.5)	Listen, watch and be involved when invited to. Answer questions. Record predictions on BLM 4g	Supervise students
Explore the water treatment plant 30 mins	Different locations around plant <i>(guided)</i>	Take the students around the water treatment plant, showing them the filters, pipe gallery and the sludge	Learn about each stage of the water treatment process	Supervise students
Experiment review 10 mins	Teaching room	Guide the students as they see what has happened in the experiments	Investigate what has happened with the experiment. Record the results on BLM 4g	Supervise and support students
Pose questions based on research 10 mins	Teaching room	Answer the students' questions or suggest an expert who the students could contact later to find answers	Ask questions based on their inquiry so far	Support and assist students
Total visit time <i>(Treatment plant only)</i>	1 ½ hours			
Total visit time <i>(Including the Stuart Mackaskill Lakes lookout and treatment plant -without Kaitoke Weir or Strainer House)</i>	2 hours			
Total visit time <i>(Including the Stuart Mackaskill Lakes lookout, treatment plant and Kaitoke Weir)</i>	2 hours and 45 minutes			
Total visit time <i>(Including the Stuart Mackaskill Lakes lookout, treatment plant, Kaitoke Weir and Strainer House)</i>	3 hours 45 minutes			



BLM 4e: Group Visitor Induction

Understanding of Responsibility: Visiting Groups

As part of our health and safety programme, we require that all visitors to Greater Wellington Regional Council (GWRC) water treatment plants 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 GWRC 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 BLM 4d for **Te Marua Water Treatment Plant**, 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: _____

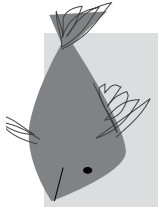
Group/School: _____

Date: _____

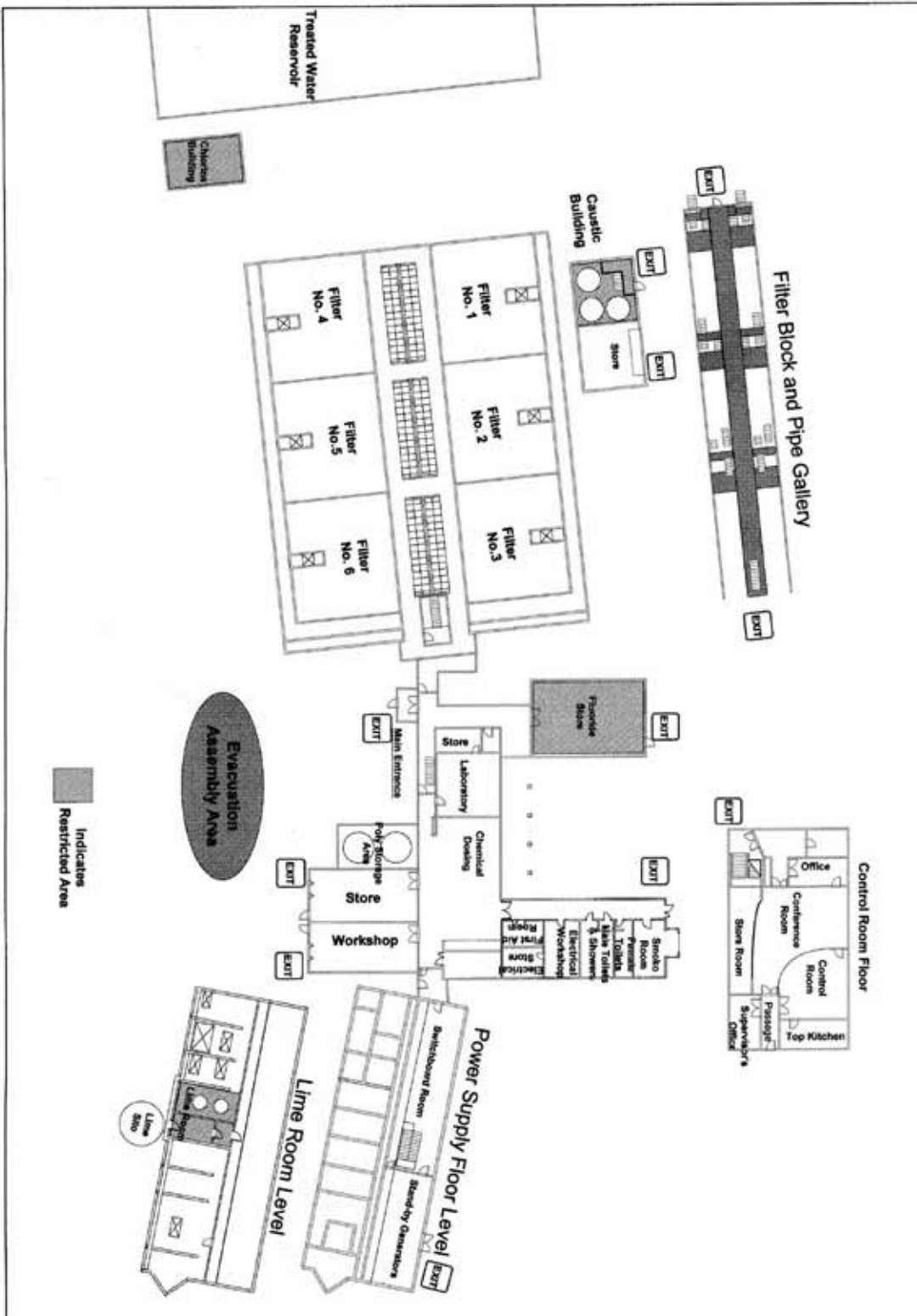
Total number of visitors: Children: _____ Adults: _____

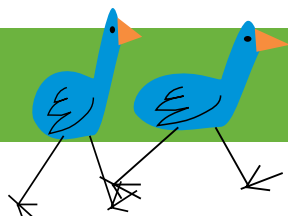
Signature: _____

** 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.*



BLM 4f: Map of Te Marua Water Treatment Plant





4:5 Experiment: Clumping with coagulants – teacher notes



Curriculum links



Science: Level 3 and 4

Material World:

Chemistry and society:

Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes

Other curriculum links:

Level 3 and 4

Science: Investigating in 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

Background knowledge

What is a coagulant?

A coagulant is a type of chemical – such as polyaluminium chloride (PACl). It helps small impurities to ‘clump’ together. Coagulant is added in the rapid mix tank in the water treatment plant. The coagulant attracts particles of solids to it and causes them to bind together. Mixing it quickly makes the clumping process work faster.

Why are coagulants used in water treatment?

Coagulants are used to remove impurities from water. They help solid and dissolved impurities clump together and they can then be more easily removed from the water.

What is floc?

Floc is a collection of solid particles suspended in water. When the small impurities from water clump together, they make ‘floc’. Floc is formed when a coagulant is added to water.

How is the floc removed?

In the settling tanks, the water separates out. The floc is large enough so that it sinks to the bottom of the tanks. The floc at the bottom of the tank is then scraped off and sent to the sludge handling plant.

What is a ‘control’?

A control in an experiment is an unchanged, normal specimen. For this experiment, it would be dirty water without the coagulant added. The control is a ‘normal’ model to compare the other specimens with.

Any valid experiment must have a control.

Safety with coagulants

Contact with the coagulant should be avoided. Those handling the chemicals may need to wear safety equipment.

4:5 Experiment: Clumping with coagulants – learning experience



Learning experience

Staff at the water treatment plant will perform this experiment while the students observe.

- Staff will ask students what they think a 'coagulant' is.
Staff will work with student's ideas to reach an acceptable definition. Staff will then explain what a coagulant does and give associated safety information for the experiment (see teacher notes)
- An experiment will be set up at the front of the room with jars of water
- The experiment will consist of up to six jars of water, each a different type
- Staff will put different types of water into each jar. Students will be involved where possible. The contents of each jar will be labelled
- What do students think will happen when a coagulant is added to water in the jars with dirt in them? *Make predictions on BLM 4g*
- Staff will then add a small dose of the coagulant (PACl) to each of the jars, except one, which will be the 'control'
- Discuss what a control is and why we need one *(see teacher notes)*
- The machine will then stir the jars. Students observe what is happening
- After mixing, leave jars to settle for at least 20 minutes. The students will leave the experiment in place while they are taken on a tour of the plant
- When the students return, they will observe and compare the physical changes of the water in each jar. *Some will have formed 'floc' (see teacher notes)*
- Discuss, with the help of staff, what happened to the water inside each jar after coagulant was added to it. *Discuss reasons for different reactions*

Learning intentions



Students will:

Observe changes to different types of water when a coagulant is added to it

Success criteria



Students can:

Explain what happens when a coagulant is added to different types of water

Resources



BLM 4g Coagulant experiment notes

Reflection questions

- Why would coagulant be used for treating water? *To clump impurities together so that they can be removed more easily*
- What is floc? *See teacher notes*
- Why did some jars not form any floc when coagulant was added? *There were few impurities in these jars*

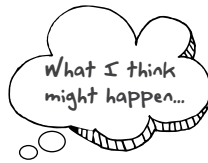
Vocabulary

- coagulant
- PACl (polyaluminium chloride)
- particles
- prediction
- observation



BLM 4g: Coagulant experiment

What is a coagulant?



Contents of jar	Prediction When coagulant is added...	Observation When coagulant was added...

Explain your observations:

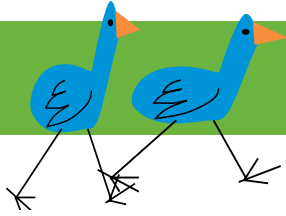
Section 4: Water treatment – Wainuiomata



Learning experiences – Section Four

Learning experiences	Learning intentions Students will . . .	Curriculum links (Achievement objectives)	Content
1. Keeping our drinking water clean	<ul style="list-style-type: none"> Identify appropriate sources of drinking water 	<p>Health: Level 3 and 4: Personal Health and Physical Development: <i>Safety management</i> Identify risks and their causes and describe safe practices to manage these</p>	Students identify clean sources of drinking water and explore the Wainuiomata/Orongorongo Water Collection Area
2. What happens at the water treatment plant	<ul style="list-style-type: none"> Investigate the sequence of events in the water treatment process Determine the function of water treatment equipment 	<p>Technology: Level 3: Nature of Technology: <i>Characteristics of technological outcomes:</i> Understand that technological outcomes are recognisable as fit for purpose by the relationship between their physical and functional natures</p>	Students investigate the water treatment process. They place cards describing parts of the water treatment process in the correct order on a flow diagram
3. Safety at the water treatment plant	<ul style="list-style-type: none"> Identify ways to manage hazards at the water treatment plant Create a safety action plan for their visit 	<p>Health: Level 3 and 4: Personal Health and Physical Development: <i>Safety management</i> Identify risks and their causes and describe safe practices to manage these</p>	Students discuss ways to manage possible hazards during their visit and collectively create a safety action plan
4. Visiting the Wainuiomata Water Treatment Plant	<ul style="list-style-type: none"> Ask questions to gain further knowledge about the water treatment process 	<p>Science: Level 3 and 4: Nature of Science <i>Investigating in science</i> – 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</p>	Visit 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
5. Experiment: Clumping with coagulants	<ul style="list-style-type: none"> Observe changes to different types of water when a coagulant is added to it 	<p>Science: Level 3 and 4: Material world: <i>Chemistry and society:</i> Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes</p>	<p><i>*This experiment will be conducted by staff at the water treatment plant</i></p> <p>Students observe and describe changes to different samples of water when a coagulant is added</p>

4:1 Keeping our drinking water clean – teacher notes



Curriculum links

Health: Level 3 and 4
Personal Health and Physical Development: Level 3

Safety management:
 Identify risks and their causes and describe safe practices to manage these

Level 4
Safety management:
 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:
 Investigating in science

Background knowledge

Collecting the cleanest water

In Wellington, water is collected from rivers where the source is as clean as possible to start with (the Hutt, Orongorongo and Wainuiomata rivers). 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 in the water at a water treatment plant.

Why collect the water from the Wainuiomata/Orongorongo Water Collection Area?

Water that is treated at Wainuiomata Water Treatment Plant comes from the Wainuiomata and Orongorongo catchments. When rain falls in the Rimutaka Ranges, water that is not absorbed into the ground starts to run downhill towards the sea through the streams of the Wainuiomata/Orongorongo Water Collection Area. The streams run through a large area of native forest, which is an ideal environment for keeping water as clean as possible.

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 while it is underground and typically water that has been underground for more than one year is free from problems. In Wellington, some 40% of our drinking water is from the Waiwhetu Aquifer. Water from the Waiwhetu Aquifer has been underground for more than a year, so the water that comes out of it doesn't need to be treated to be safe to drink.

Weirs for collecting water

A weir is a small dam. It raises the water level in one part of the river to help divert water into an intake chamber. While most of the water flows on down the river, some flows into the intake chamber and on to the water treatment plant for treating. The area around our weirs is managed to reduce the risk of the water becoming polluted. Possible pollutants could include: animal and human waste, soil, rubbish, chemicals, oil and petrol. To manage this risk, grazing stock and vehicles are kept out of the water collection area above the weir, and although people can walk in nearby areas, they are not allowed to camp in those places overnight.



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

4:1 Keeping our drinking water clean – learning experience



Learning experience

- Share the learning intention and success criteria
- Ask students where they would collect drinking water if there was no town supply available. *Examples include: drinking fountain at Petone, streams high in the catchment, catching rainwater*
- Explain that water 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 'Greater Wellington's water sources'. Point out aquifers, rivers and the sea on the diagram. Read out 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 Wellington's water supply from the Hutt Water Collection Area, the Wainuiomata/Orongorongo Water Collection Area and from the Waiwhetu Aquifer. *The Hutt Water Collection Area and the Waiwhetu Aquifer each provide about 40% of Wellington's supply. The remaining 20% of the water supply is taken from the Wainuiomata/Orongorongo Water Collection Area*
- Locate the Orongorongo and Wainuiomata rivers on a map. Ask students why this area would have been chosen for a water collection area? (see teacher notes). *For more information about Wellington's water supply see: <http://www.gw.govt.nz/sources-of-water/>*
- Brainstorm questions about water treatment. Record questions to ask during the water treatment plant visit

As an extension, students could research water borne diseases. See: <http://www.health.govt.nz/uploads/docs/IHE213.pdf>

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

Learning intentions



Students will:

Identify appropriate safe sources of drinking water

Success criteria



Students can:

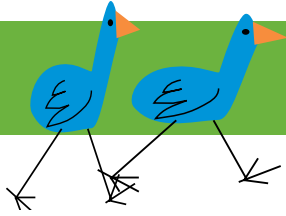
Identify appropriate places to source safe drinking water

Resources



Poster Greater Wellington's water sources

4:2 What happens at the water treatment plant – teacher notes



Curriculum links

Technology: Level 3 and 4

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

Other curriculum links at Level 4:

Health: *Movement concepts and motor skills: Science and Technology:*

Experience and demonstrate how science, technology and the environment influence the selection and use of equipment in a variety of settings



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

Background knowledge

Water treatment – the process

Before the water treatment plant

Water is collected from a natural source. For the Wainuiomata Water Treatment Plant, water is collected at **weirs** on the largest accessible rivers in the Wainuiomata/Orongorongo Water Collection Area.

Screening the water

The water that has been collected must be screened to remove any debris. At the **weir**, water passes through **bar screens** which have holes that are 15-20 mm wide. Big items, such as, grit, sand, gravel, rocks, sticks and leaves, are flushed back into the river. Small fish can swim into the intake chamber but they usually swim out again. Large fish are prevented from entering the intake chamber by a large grid.

Although we have collected the water from the cleanest possible source, there will still be impurities in it that are too small to see or catch in the bar screens.

Inside the water treatment plant

Clumping impurities

Because the impurities floating in the water are very small, it's easier to get them out if we can **clump** them together in bigger groups. In the reaction tanks, we add chemicals like Polyaluminium Chloride (PACl) to the water which attract the suspended particles like a magnet and bind them together into larger particles that we can see (called **floc**).

Separating out the floc to remove impurities

Millions of tiny bubbles of air are pumped into the water. The bubbles join onto the floc, floating them to the surface where they form a 'floc blanket'. The blanket of floc then floats to the one end of the tank where it is tipped over the edge of the tank and into the wastewater system by a tilting tray. The waste is sent to a **centrifuge**, which spins really fast, removing the excess water like the spin cycle in a washing machine, returning the clean water to the inlet to the water treatment plant (a great example of recycling) and leaving behind solid sludge.

The sludge is sent along a **conveyer belt** and down into a skip to be taken to the landfill at Wainuiomata. *(Without fail, the student's favourite part of the water treatment plant visit is watching the sludge plop onto the conveyer belt and then off into the skip.)*



Filtering the water

The water that is left under the floc blanket flows through a **sand filter** at the bottom of the tank. This acts like a very fine screen, trapping and separating out any last particles that didn't float to the top.

Making sure the water is safe to drink

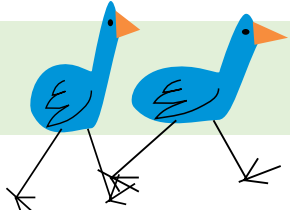
The clean drinking water is almost ready for our taps. The water has a long way to go from the water treatment plant, through pipes to local storage reservoirs and then through more pipes before it reaches our taps – it might take 2 days to get from the Wainuiomata Water Treatment Plant to a **reservoir** in Wellington city. Before the water goes to the treated water reservoir we add chlorine to kill any bugs that may remain in the water or that might enter the water over the long journey. About 5 million litres can be stored in the treated water reservoir at Wainuiomata at a time. Fluoride is also added before it reaches our taps, to help keep our teeth strong and healthy.

The water is monitored throughout the treatment process to make sure it meets our country's drinking water standards.

What is a technological outcome?

Technological outcomes are products and systems developed for a specific purpose. A technological outcome is evaluated in terms of its fitness for purpose.

4:2 What happens at the water treatment plant – learning experience



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

BLM 4h The water treatment process: Wainuiomata

BLM 4i Water treatment process cards: Wainuiomata

Poster Water treatment process – Wainuiomata

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 the equipment used in a water treatment plant and the sequence of events that is undertaken to treat water to drinking standards
- Read aloud the teacher notes on pages 92-93 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 BLM 4h and BLM 4i. Discuss any new vocabulary and clarify meaning
- Ask students to cut out cards on BLM 4i. Stick into the correct box under picture on BLM 4h. Each card explains a step in the water treatment process
- When students have ordered the cards ask them to compare answers
- Show students the poster 'Water treatment process – Wainuiomata'. Revise the steps of the water treatment process with the poster as a guide, while students determine if their cards are in the correct order
- Discuss any equipment featured on the poster and cards. Ask what each piece of equipment's function is. *Treatment plant equipment is in **bold** on teacher notes pages*

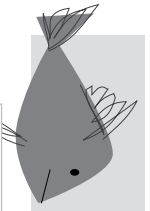
As an extension, students could create a flowchart to describe the process of water treatment.

Reflection questions

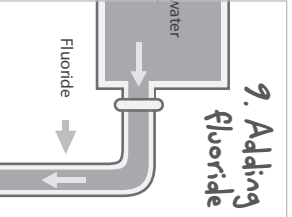
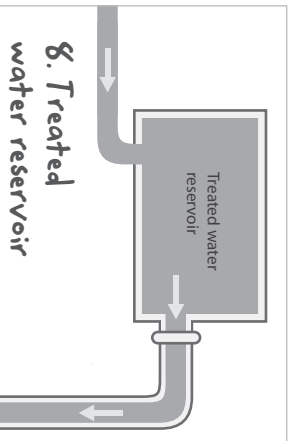
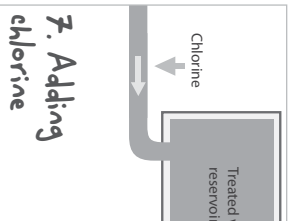
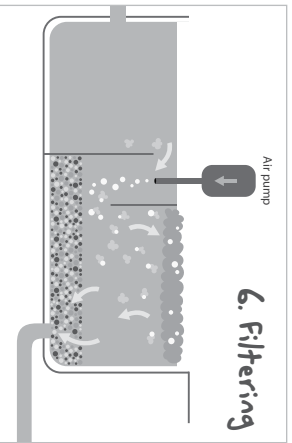
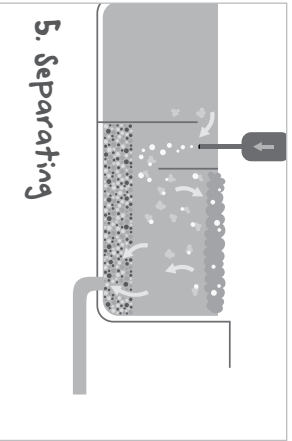
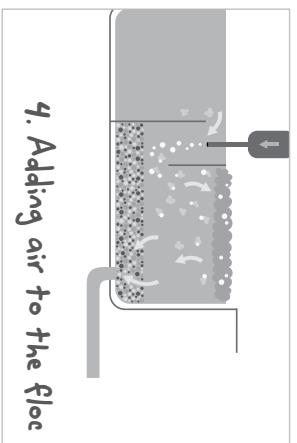
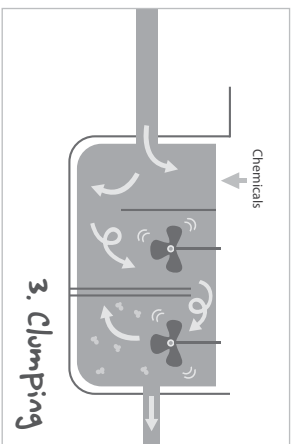
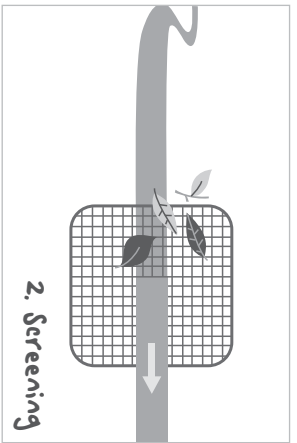
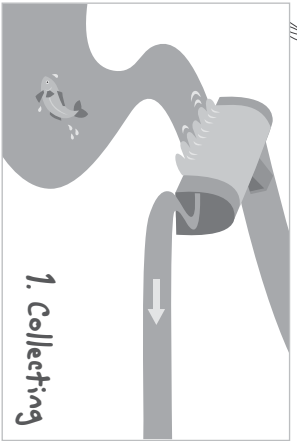
- Why do you think the water has to be as clean as possible before the water treatment process starts? *It takes less effort and resources to treat water to drinking-quality standards if water is relatively clean to start with*
- How do staff make sure that all impurities have been removed? *Water is thoroughly tested along the way before being distributed*

Vocabulary

- filtering
- floc
- chlorine
- fluoride



BLM 4h: The water treatment process: Wainuiomata





BLM 4i: Water treatment process cards: Wainuiomata

Cut out the cards below. Place each card in the appropriate space on BLM 4h to describe the order of the water treatment process.

Rain falls and collects in streams and rivers in the Wainuiomata/Orongorongo Water Collection Area. Some of this water flows into the water supply intakes to the water treatment plant.

Millions of bubbles of air are also added. These stick to the floc, making them rise to the surface in a layer which looks like a blanket.

Fluoride is later added to help keep our teeth healthy.

We add chemicals to the water and stir it. This helps all the impurities clump together to make 'floc'. Floc is easier to see and to get out.

The treated water is almost ready to be distributed to the community.

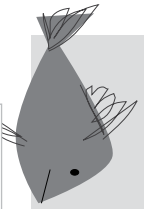
The floc is then tipped off the surface of the tank with a tilting tray. The floc is separated from the water to make sludge waste. The sludge is carried away to a skip bin.

The water goes through a fine screen to stop leaves, branches and gravel from getting into the water treatment plant.

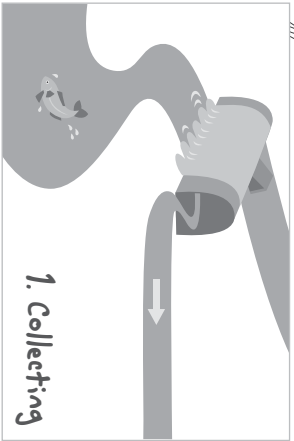
The remaining water passes through a set of sand filters. These filters act like very fine screens trapping and separating out any last unwanted, small impurities.

Chlorine is added to the water to kill any bugs that might be in the water.



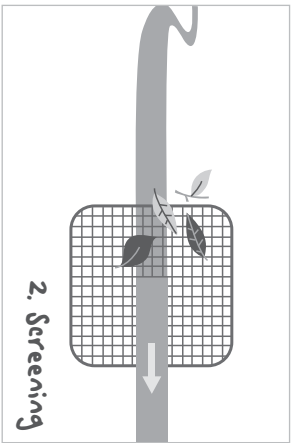


BLM 4: The water treatment process: Wainuiomata – Answer sheet



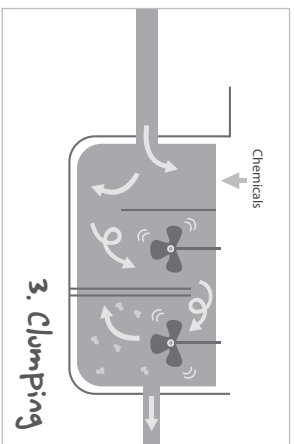
1. Collecting

Rain falls and collects in streams and rivers in the Wainuiomata/Orongorongo Water Collection Area. Some of this water flows into the water supply intakes to the water treatment plant.



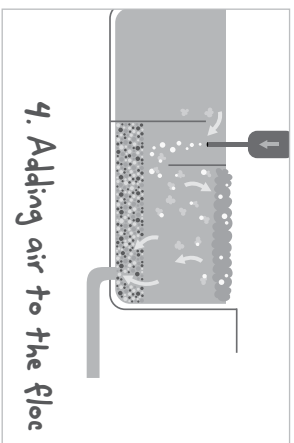
2. Screening

The water goes through a fine screen to stop leaves, branches and gravel from getting into the water treatment plant.



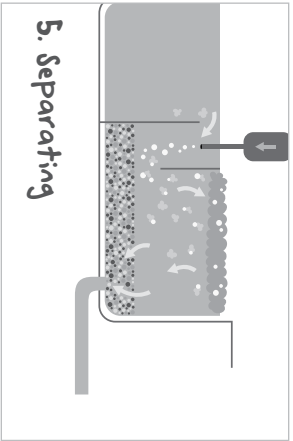
3. Clumping

We add chemicals to the water and stir it. This helps all the impurities clump together to make 'floc'. Floc is easier to see and to get out.



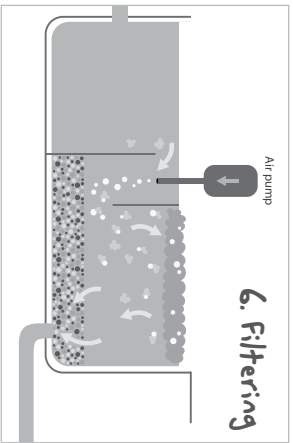
4. Adding air to the floc

Millions of bubbles of air are also added. These stick to the floc, making them rise to the surface in a layer which looks like a blanket.



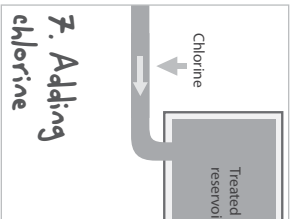
5. Separating

The floc is then tipped off the surface of the tank with a tilting tray. The floc is separated from the water to make sludge waste. The sludge is carried away to a skip bin.



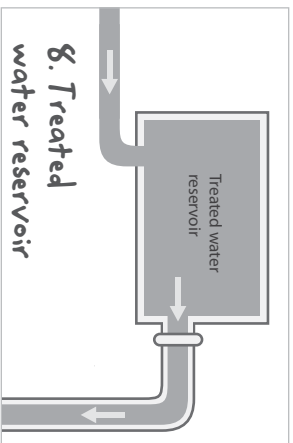
6. Filtering

The remaining water passes through a set of sand filters. These filters act like very fine screens trapping and separating out any last unwanted, small impurities.



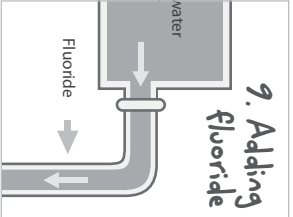
7. Adding chlorine

Chlorine is added to the water to kill any bugs that might be in the water.



8. Treated water reservoir

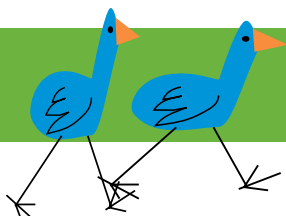
The treated water is almost ready to be distributed to the community.



9. Adding fluoride

Fluoride is later added to help keep our teeth healthy.

4:3 Safety at the water treatment plant – teacher notes



Curriculum links

**Health: Level 3 and 4
Personal Health
and Physical
Development: Level 3**

Safety management:
Identify risks and their causes and describe safe practices to manage these

Level 4

Safety management:
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

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 can't 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-process-img.asp> for more information

NB: Teachers need to complete BLM 4k: Visitor Information and BLM 4l: Group visitor induction on behalf of their students and give to water treatment plant staff on the day of their visit.

4:3 Safety at the water treatment plant – learning experience



Learning experience

- Share learning intentions and success criteria
- Ask students if they understand what a hazard is (*see teacher notes*)
- Explain the need for a safety action plan
- Brainstorm what risks/hazards there might be at a water treatment plant. *Read BLM 4k for examples*
- 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 BLM 4j. 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



BLM 4j Safety action plan for plant visit

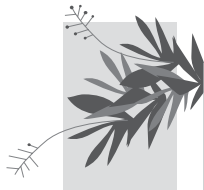
BLM 4k Visitor information: Wainuiomata

Reflection questions

- Is there anything else we could do to keep ourselves safe at the treatment plant? *Answers will vary*
- How could sludge waste be harmful? *See BLM 4k*

Vocabulary

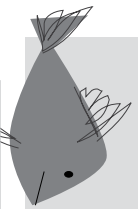
- impurities
- purification



BLM 4j: Safety action plan for water treatment plant visit

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			
Injury from machinery in plant	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers			
Electric shock	Uncontrolled access to electrical cabinets	Supervising teacher, students, parents/helpers			
Fall into open water	Climbing over barrier	Supervising teacher, students, parents/helpers			
General fall	Running, not paying attention	Students, supervising teacher, parents/helpers			
Contact with sludge waste	Uncontrolled access to restricted areas	Supervising teacher, students, 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			

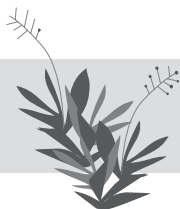




BLM 4j: Safety action plan for water treatment plant visit: possible answers

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
Injury from machinery in plant	Uncontrolled access to restricted areas	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers, 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)
Fall into open water	Climbing over barrier	Supervising teacher, students, parents/helpers	Instruct students to stay behind all barriers, supervision by parents/teachers	Before visit, at start of plant tour	Adult to retrieve student Call an ambulance/apply first aid
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
Contact with sludge waste	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	Wash hands immediately
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 the visit; 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)





BLM 4k: Visitor Information: Wainuiomata

Welcome to the Wainuiomata 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 and note the emergency provisions on BLM 4m. 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
- Open water surfaces
- Rotating machinery
- Sludge waste

Corrosive and toxic chemicals

The following chemicals are stored and used on this site. The storage location of these chemicals is identified on the site plan BLM 4m.

Chemical	Hazard	Health Effects
Chlorine Gas	Poisonous and Highly Corrosive	Asphyxiation/Pulmonary Oedema
Carbon Dioxide Gas	Displaces Oxygen	Asphyxiation
Fluoride	Toxic	Poisoning
Aluminium Sulphate	Mildly Corrosive	Minor Burns
Hydrated Lime	Mildly Corrosive	Minor Burns

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.

Rotating machinery

Please be aware that the Treatment Plant is fully automated and therefore machinery could start at any time. All exposed rotating parts have been fitted with guards to prevent accidental contact. **Keep clear of any working machinery and equipment.**

Sludge Waste

Most contaminants, including Viruses, Giardia and Cryptosporidium, are removed from the raw water and concentrated in the sludge waste. **Do not handle this waste.** Wash your hands if accidental contact occurs.

In the event of an emergency make your way quickly to the evacuation area shown on map (BLM 4m)

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: _____

4:4 Visiting the Wainuiomata 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.

To organise a date and time to visit the water treatment plant, contact our staff; ph: (04) 384 5708 or email: info@gw.govt.nz

A suggested itinerary is included – see *Visit schedule: Wainuiomata Water Treatment Plant* on pages 105 and 106. You may choose to only visit the water treatment plant.

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.

Wainuiomata Lower Dam

Visiting the Wainuiomata Lower Dam is optional. The dam is located just before the Wainuiomata Water Treatment Plant (*on the right as you drive in*).

It is a large, decommissioned dam which is no longer part of the water supply infrastructure. The dam was finished in 1884 and is one of the oldest dams in New Zealand.

The dam is approximately a two minute drive from the water treatment plant. There are no guides available at the dam. Further health and safety documentation and checks may be necessary by the teacher before visiting the dam. The large grassy area behind the dam is ideal for a morning tea or lunch break.

Wainuiomata hydro-electric generator

A hydro-electric generator has been constructed near the Wainuiomata Water Treatment Plant. It is a five minute walk from the water treatment plant. It has an information panel about the generator and offers the opportunity for your students to look through the door of the plant at the equipment. The hydro-electric generator uses water collected at the Orongorongo Weir to generate electricity.

If you wish to visit the hydro-electric generator please indicate this when booking your tour.

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

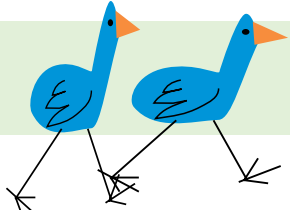
Ask questions, find evidence, explore simple models, and carry out appropriate investigations to develop simple explanations

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

4:4 Visiting the Wainuiomata Water Treatment Plant – learning experience



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

Learning experience

The visit schedule pages 105 and 106 summarises the visit to the Wainuiomata Water Treatment Plant. It outlines the responsibilities of the water treatment plant staff, teachers and students. **Please read it carefully before your scheduled visit.**

Prior to your visit, ensure that you have sent a notice home to parents detailing what students need to bring (*'what to take' – teacher notes*). Also discuss your expectations of students before the visit.

After the tour of the water treatment plant, you may want to also visit the Wainuiomata Lower Dam or the Wainuiomata hydro-electric generator. The Wainuiomata Lower Dam is unguided, and both are a worthwhile add-on to a trip (*see teacher notes*).

The maximum group size is 30 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.

What to take:

Students:

- Sensible walking shoes
- A warm jacket
- Sunblock and a hat
- **BLM 4n** Coagulant experiment notes, *1 copy between 2*
- Digital cameras (if possible)
- Prepared questions for the staff at the water treatment plant (*ideally email these prior to the visit*)
- Pen and something firm to press on
- Food and drink

Teachers:

- **BLM 4k** Visitor information (completed) *to give to guide*
- **BLM 4l** Group visitor induction (completed) *to give to guide*
- **BLM 4m** Map of Te Marua Water Treatment Plant
- A list of students and adults present at visit *to give to the guide*
- Health and safety documentation
- First aid kit

Resources



BLM 4k Visitor information:Wainuiomata

BLM 4l
Group visitor induction

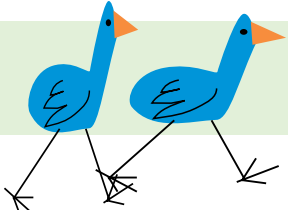
BLM 4m Map of Wainuiomata Water Treatment Plant

BLM 4n Coagulant experiment for students to complete during experiment)



Visit schedule: Wainuiomata Water Treatment Plant

Activity and timeframes	Where	What happens at each point:		
		What do the guides do?	What do the students do?	What does the teacher do?
Meet the guides 10 mins	Front door	<ul style="list-style-type: none"> Introduce themselves and lead group through to teaching room Explain what their jobs involve Give health and safety talk 	Listen	Supervise students
Introduction 5 mins	Teaching room	<ul style="list-style-type: none"> Ask students what they already know about why we need to treat water Show pictures of giardia and cryptosporidium bugs 	Listen, answer questions	Encourage students
Viewing the water treatment process diagram 15 mins	Teaching room	<ul style="list-style-type: none"> Ask students what they already know about the water treatment process Add information about each step to extend students' knowledge and understanding. Encourage critical thinking Allow opportunities for several questions 	Share their knowledge	Circulate and help students
Experiment: Coagulation 10 mins	Teaching room	Set up and discuss coagulant experiment (learning experience 4.5)	Listen, watch and be involved when invited to. Answer questions Record predictions on BLM 4n	Supervise students
Explore the water treatment plant 30 mins	Different locations around plant (guided)	Take the students around the water treatment plant, showing them the filters, pipe gallery and the sludge	Learn about each stage of the water treatment process	Supervise and support students



Activity and timeframes	Where	What happens at each point:		
		What do the guides do?	What do the students do?	What does the teacher do?
Experiment review <i>10 mins</i>	Teaching room	Guide the students as they see what has happened in the experiments	Investigate what has happened with the experiment. Record the results on BLM 4n	Supervise and support students
Pose questions based on research <i>10 mins</i>	Teaching room	Answer the students' questions or suggest an expert who the students could contact later to find answers	Ask questions based on their inquiry so far	Supervise and support students
Total visit time <i>(Treatment plant only)</i>	1 ½ hours			
Total visit time <i>including Wainuiomata Lower Dam and/or hydro-electric generator)</i>	Approximately 2 hours			



Map of Wainuiomata Water Treatment Plant



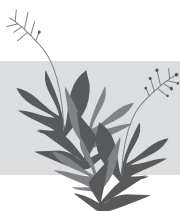
Morton Dam

Parking

Hydro-electric generator

Water treatment plant

Wainuiomata Lower Dam



BLM 4I: Group Visitor Induction

Understanding of Responsibility: Visiting Groups

As part of our health and safety programme, we require that all visitors to Greater Wellington Regional Council (GWRC) water treatment plants 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 GWRC 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 information on BLM 4k for **Wainuiomata Water Treatment Plant**, 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: _____

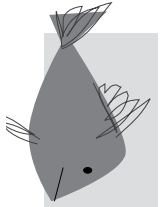
Group/School: _____

Date: _____

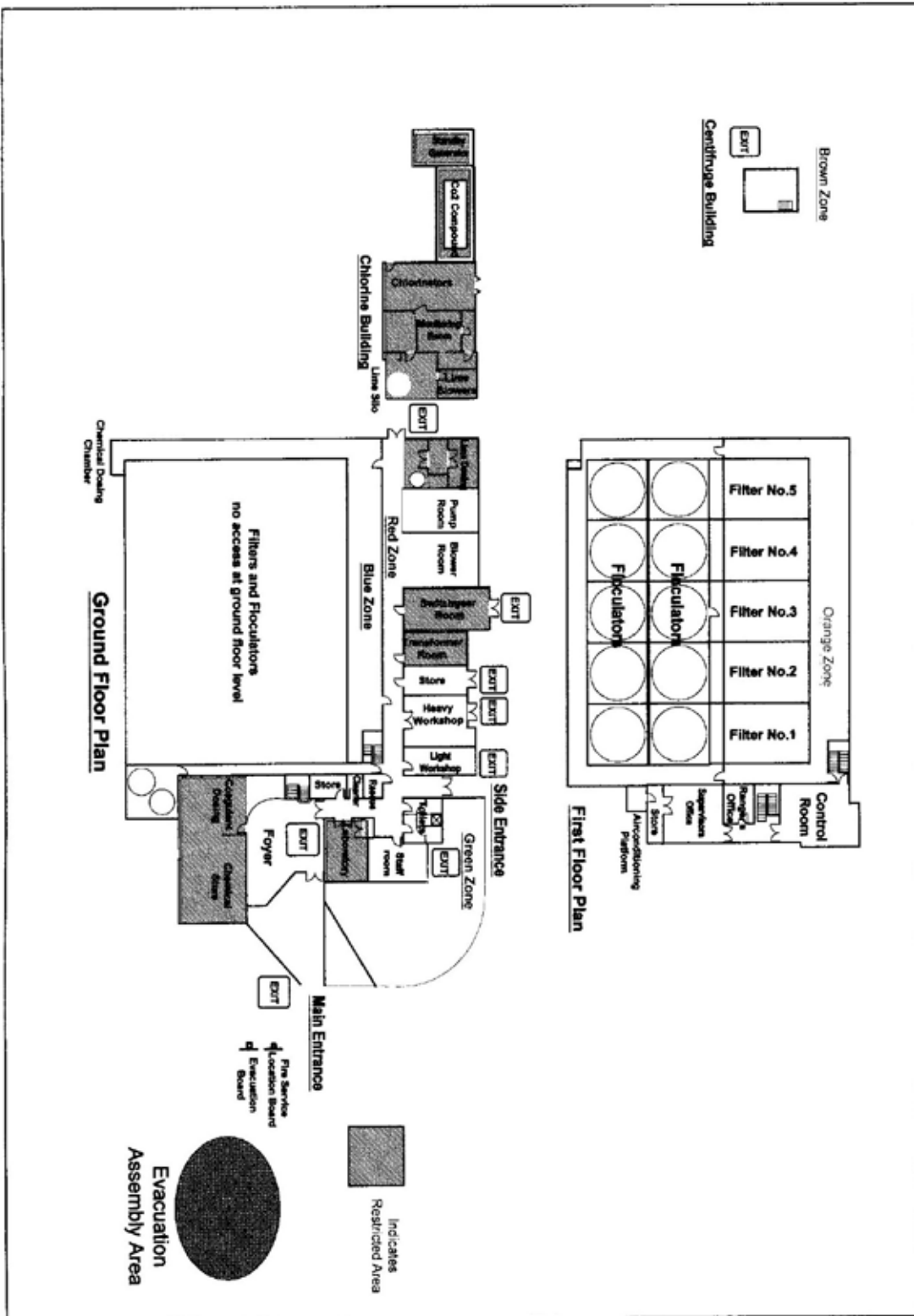
Total number of visitors: Children: _____ **Adults:** _____

Signature: _____

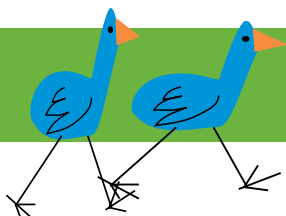
* Please bring with you, attached to this form, a list of the names of all children and adults who are included in your group, ensuring that it is accurate on the day of the visit. This will help us to account for your group members quickly in the unlikely event of an emergency occurring while you are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



BLM 4m: Map of Wainiomaata Water Treatment Plant



4:5 Experiment: Clumping with coagulants – teacher notes



Curriculum links

Science: Level 3 and 4

Material World:

Chemistry and society:

Relate the observed, characteristic chemical and physical properties of a range of different materials to technological uses and natural processes

Other curriculum links:

Level 3 and 4

Science: Investigating in 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.

Background knowledge

What is a coagulant?

A coagulant is a type of chemical – such as polyaluminium chloride (PACl). It helps small impurities to ‘clump’ together. Coagulant is added in the rapid mix tank in the water treatment plant. The coagulant attracts particles of solids to it and causes them to bind together. Mixing it quickly makes the clumping process work faster.

Why are coagulants used in water treatment?

Coagulants are used to remove impurities from water. They help solid and dissolved impurities clump together and they can then be more easily removed from the water.

What is floc?

Floc is a collection of solid particles suspended in water. When the small impurities from water clump together, they make ‘floc’. Floc is formed when a coagulant is added to water.

How is the floc removed?

Millions of tiny bubbles of air are pumped into the water. The bubbles join on to the floc and helps the floc float to the surface, forming a floc blanket. The floc blanket is pushed to one end of the tank where it is tipped over the edge by a tilting tray. The floc is sent to the sludge handling plant.

What is a ‘control’?

A control in an experiment is an unchanged, normal specimen. For this experiment, it would be dirty water without the coagulant added. The control is a ‘normal’ model to compare the other specimens with. Any valid experiment must have a control to compare against.

Safety with coagulants

Contact with the coagulant should be avoided. Those handling the chemicals may need to wear safety equipment.

4:5 Experiment: Clumping with coagulants – learning experience



Learning experience

Staff at the water treatment plant will perform this experiment while the students observe.

- Staff will ask students what they think a 'coagulant' is.
*Staff will work with student's ideas to reach an acceptable definition.
Staff will then explain what a coagulant does and give associated safety information for the experiment (see teacher notes)*
- An experiment will be set up at the front of the room with jars of water
- The experiment will consist of up to six jars of water, each a different type
- Staff will put different types of water into each jar. Students will be involved where possible. The contents of each jar will be labelled
- What do students think will happen when a coagulant is added to the water in the jars with dirt in them? *Make predictions on BLM 4n*
- Staff will then add a small dose of the coagulant (PACl) to each of the jars, except one, which will be the 'control'
- Discuss what a control is and why we need one (*see teacher notes*)
- The machine will then stir the jars. Students observe
- After mixing, leave jars to settle for at least 20 minutes. *The students will leave the experiment in place while they are taken on a tour of the plant*
- When the students return, they will observe and compare the physical changes of the water in each jar. They can then complete the observation column on BLM 4n. *Some jars will have formed 'floc' (see teacher notes)*
- Discuss, with the help of staff, what happened to the water inside each jar after coagulant was added to it. *Discuss reasons for different reactions*

Learning intentions



Students will:

Observe changes to different types of water when a coagulant is added to it

Success criteria



Students can:

Explain what happens when a coagulant is added to different types of water

Resources



BLM 4n Coagulant experiment notes

Reflection questions

- Why would coagulant be used for treating water? *To clump impurities together so that they can be removed more easily*
- What is floc? (*see teacher notes*)
- Why did some jars not form any floc when coagulant was added?
There were few impurities in these jars

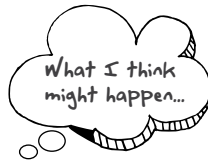
Vocabulary

- coagulant
- PACl (polyaluminium chloride)
- particles
- prediction
- observation



BLM 4n: Coagulant experiment

What is a coagulant?



Contents of jar	Prediction When coagulant is added...	Observation When coagulant is added...

Explain your observations: