Water is the driving force in nature

- Leonardo da Vinci

Central Coast Council - Water Education Program

Stage 3 - Love Water, Use it Wisely

Do the earth a favour, be a water saver

CONTENTS

Mardi Dam

INTRODUCTION

Central Coast Council is proud to present the 'Love Water, Use it Wisely' School Water Conservation Program, designed to support the Stage 3 Science unit 'Digital Technologies' and Stage 3 Maths units 'Whole Numbers 2 & Data 1'. This program has a strong focus on water use and conservation within the school and in the context of the Central Coast catchment. Throughout this program students will learn about the water cycle, water management, catchments, conservation and what Central Coast Council implements to ensure a safe and reliable water supply for the community.

IMPLEMENTATION

Activities are designed to be taught in sequence and as part of the Stage 3 Science unit 'Digital Technologies' and Maths unit 'Whole Numbers 2 & Data 1', however, each activity is self-contained and may be utilised as a stand-alone activity to compliment any water conservation education program.

This program is designed to be taught as a collaboration between the school's teachers and Central Coast Council's Environmental Education Officers, with Council offering a FREE incursion program, as well as the optional installation of a Smart Water Data Logger for FREE to schools for two months during this program. However, this program can be taught independently.

- **Incursion One (1hr)**
  A Central Coast Council Environmental Education Officer will come to your school to introduce the program and provide information on the Central Coast water supply system and challenges facing the Central Coast's water supply. This workshop will also introduce you to the web portal for your school's Smart Water Data Loggers (optional).
- **Drain or not to Drain (1hr)**
  How does soil impact our water on the Central Coast? Students experiment with three types of soil to understand this interaction.
- **The Drip Trip (1.5hrs)**
  This activity provides an interactive immersion into how the Central Coast Water Supply works. Students become experts in various components of the water supply system while adding their specific items to the diagram along the way.
- **Water Audit Activity (2hrs)**
  How does your school use water? Students are challenged to investigate how and where your school uses the most water.
- **Incursion Two (1hr)**
  A Central Coast Council Environmental Education Officer will re-visit your school to help investigate the findings of your water audit and the data obtained by the Smart Water Data Logger to create a water management plan designed by the students.
- **Waterwise Garden (1.5hrs)**
  Students get to measure, audit and collect data about the water efficiency of the gardens at school. How waterwise is your schools garden? Let's dig in!
- **Running Dry (1.5hr)**
  Groundwater bores are used all around Australia to access water. Students get to use a simulation to learn more about bores and the potential impacts on the environment.

BONUS!

- **Smart Water Data Loggers**

Water audits are a tool for homes, business and schools to look at their own water consumption to see where they can make effective changes to lessen their water usage. New technology exists in the form of Smart Water Data Loggers that provides instantaneous data to the consumer. Central Coast Council is providing this technology for **FREE** to schools for two months during this program. All activities can be facilitated without this component but utilising this free technology will provide students with added information and learning potential.

Smart Water Data Logger Installation Process	Benefits of a Smart Water Data Logger at your school
• Contact the Environmental Education Team at Central Coast Council to express your school's interest in participating in the program • An installation date will be organised prior to the program commencing • A personalised web portal will be set up to provide you with a secure site to view your school's water usage data • De-installation will be organised to remove the data logger once the program has been completed (approximately eight weeks)	• Students and teachers will have access to data that can aid them in the development of a water management plan for the school • Ability to identify leaks that could be causing damage, wasting water and costing money • Ability to determine the school's baseline water usage and identify patterns of peak usage • Potential to save money at the same time as saving our precious water resources

BONUS!

- **Water Treatment Plant Excursion (Optional) (1.5hrs)**

Schools that participate in the Love Water, Use it Wisely program receive an exclusive invitation to a **FREE** excursion to a Water Treatment Plant and Dam. Students will learn about the processes involved in producing clean drinking water for the Central Coast and the strategies involved in the development of a reliable supply for provision to the community.

**Think, you can't do anything without water.
Save it.**

Mardi Treatment Plant

STAGE 3 SCIENCE

Digital Technologies

FOCUS AREA - Digitial Technologies

Outcomes explored

A student:

- Plans and uses materials, tools and equipment to develop solutions for a need or opportunity ST3-2DP-T

Skills Focus

- Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships
- Employ appropriate technologies to represent data
- Compare data with predictions
- Present data as evidence in developing explanations

Content focus

Students:

- Develop knowledge and understanding of project management
- Learn abstraction and the relationship between models and real-world systems they represent

Content:

- Using and Interpreting Data

Australian Syllabus Links:

- ACHGK037
- ACTDIK015
- ACSIS090ACSIS107
- ACSIS218
- ACSIS221

STAGE 3 MATHS

Whole Numbers 2

FOCUS AREA - Whole Numbers 2

Outcomes explored

A student:

- Gives a valid reason for supporting one possible solution over another MA3-3WM

Content focus

Students:

- Interpret integers in everyday contexts, eg temperature

Australian Syllabus Links:

- ACMNA124

STAGE 3 MATHS

Data 1

FOCUS AREA - Data 1

Outcomes explored

A student:

- Gives a valid reason for supporting one possible solution over another MA3-3WM
- uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables MA3-18SP

Content focus

Students:

- Pose questions and collect categorical or numerical data by observation or survey
- Constructs displays, including column graphs, dot plots and tables, appropriate for data type with and without the use of digital technologies
- Describe and interpret different data sets in context

Australian Syllabus Links:

- ACMSP118
- ACMSP119
- ACMSP120

Central Coast Water Supply System

STAGE 3 SCIENCE

School Water Audit Activity

FOCUS AREA - Digitial Technologies

Outcomes explored

A student:

- Plans and uses materials, tools and equipment to develop solutions for a need or opportunity ST3-2DP-T

Skills Focus

- Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships
- Employ appropriate technologies to represent data
- Compare data with predictions
- Present data as evidence in developing explanations

Content:

- Using and Interpreting Data

Content focus

Students:

- Develop knowledge and understanding of project management
- Learn abstraction and the relationship between models and real-world systems they represent

Australian Syllabus Links:

- ACHGK037
- ACTDIK015
- ACSIS090ACSIS107
- ACSIS218
- ACSIS221

STAGE 3 MATHS

School Water Audit Activity

FOCUS AREA - Whole Numbers 2

Outcomes explored

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School Water Audit Activity

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Australian Syllabus Links:

- ACMSP118
- ACMSP119
- ACMSP120

SCHOOL WATER AUDIT PROGRAM

What is a Water Audit?

Water audits are an important tool in monitoring water usage and finding better ways to lower water consumption so that everyone has water for the future. Looking at various objects in and around our school that use water will provide a good indicator of where water is being used on a daily basis.

Why is an Audit important?

Water is a resource that is vital to all living things. Having a reliable source of water is an ongoing challenge around the world to meet the needs of the environment and the people. The Central Coast is an ever-growing community of businesses, schools, hospitals, homes and farms that use water daily. A water audit is an important tool that allows us to better manage our water usage to ensure we have water for the future.

Let's Do a Water Audit!

What do we need to start?

- School's Water Bill
- School's water meter
- Interview sheets
- Audit recording sheet

Water Meter

How to read the water bill

Water meters are being read every quarter (three monthly) by meter readers to record how much water you have used over that period. This process is no different for schools. The water bill is generated to show you how much water in Kilolitres (1000 litres) the school has used and the cost per kilolitre based on that meter reading.

Using your school's water bill calculate the total cost of water used.

Central Coast Council

love water use it wisely — Can you Live to 150L per person per day? centralcoast.nsw.gov.au/lovewater

Central Coast Council
Address line 1
Address line 2

Property Location:
Street SUBURB NSW 22**
LOT 1 DP 123456

Water Account

ABN 73 149 644 003

Account details

Assessment Number	**02034019**
Issue date	**27 Jul 2018**
Due date	**27 Aug 2018**

Summary

Balance brought forward	**$0.00**
Current Charges	**$271.90**
Pension rebate	**CR $43.75**

Total amount payable **$228.15**

Due date 27 Aug 2018

Deduct payments since 20 July 2018

DIRECT DEBIT IN PLACE

Your Account Itemised

Service Charges For the period

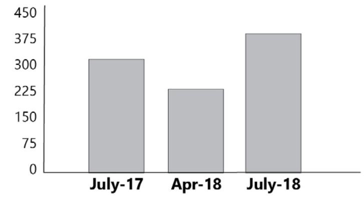
	No. of Services	Charge	Amount
Water Service - Residential	1	41.15	41.15
Sewer Service - Residential	1	120.82	120.82
Drainage Service Charge - Residential	1	32.08	32.08
Total Service Charges			**$194.05**

Usage Charges Water meter reading details over the page

	Usage (kL)	Tariff Tariff	Amount
Water Usage	34	2.29	77.85
Total Usage Charges			**$77.85**

Your average daily water usage (litres)

1kL = 1000 litres



B PAY Biller Code: 7583
Biller Ref: 02034019

BPAY® this payment via internet or phone banking
BPAY View® View and pay this bill using internet banking
BPAY View® Registration No. 02034019

Online Services ID 123987

Central Coast Council
Central Coast Council
ABN 73 149 644 003

POST billpay
21234566

Send payments to: Central Coast Council
GPO Box 2518
Sydney NSW 2001

This address is for payments only, not for general correspondence.

Payment Slip

Assessment No.	02034019
Date Due	27 Aug 2018
Amount Due	$228.15
Date Paid	
Amount Paid	

Cheque Details
Please do not attach cheque or money order with staples or pins

Drawer	
Bank	
Branch	

000000039234556 000773 0000000000 0000025076

Time to do some simple math!

	Usage (kL)		Tariff ($)		Amount
Example	34	X	2.29	=	$77.86
School		X		=	

WHAT IS OUR AVERAGE DAILY WATER USAGE AT SCHOOL?

How to work out your water usage?

When determining your school's average water use per person, we need two important items:

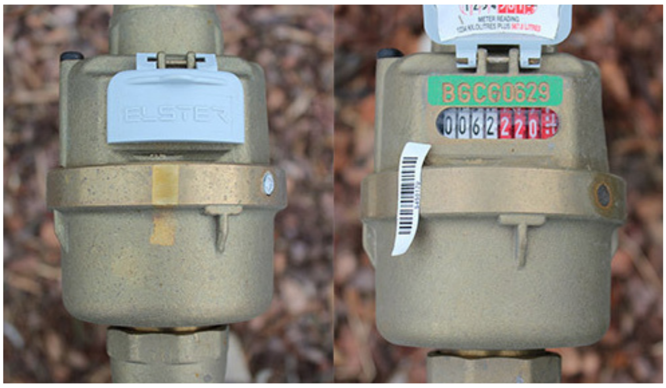
1. Total water used (kL) **Hint: water bill**

2. Total student/teacher number at school

The website link below allows you to access your school's enrolment and teaching staff for this calculation

www.myschool.edu.au

Once we have both total water used and total student/teacher numbers we can do the calculation.



Water Meter

Converting kL to Litres

Schools' (kL)				Total Litres
kL	X		=	L

Average Water Use

Total Litres		Total Students teachers		Average water use per person
L	+		=	L

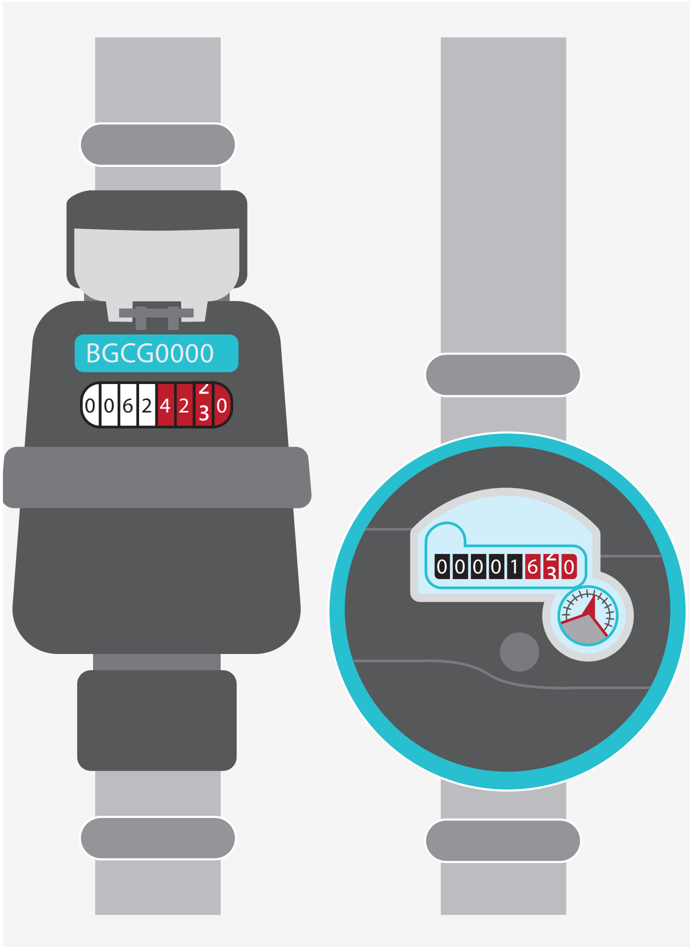
Daily Average Water Use

Average water use per person		Days at school		Average water use per person per day
L/person	+		=	L

Use the colours to help guide you to calculate the average water use per person per day

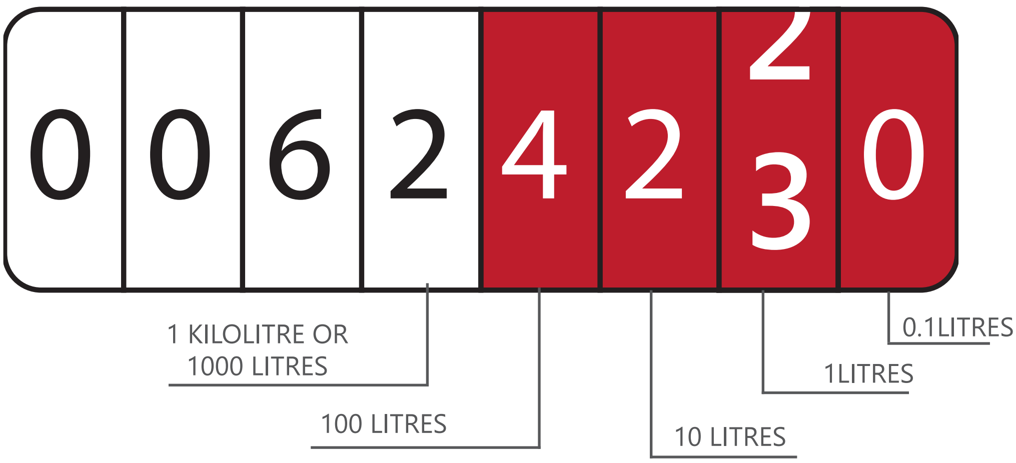
WHAT IS A WATER METER?

Water meters are devices that allow the measurement of water as it passes through to homes, schools and businesses. When you want to see how much water that has been used at any given time you can read the meter to get an accurate number. Water meters are often found near the perimeter of the schools or close to streets. Typically, schools have one water meter monitoring their usage, but it's not uncommon for larger schools to have more than one.



HOW TO READ THE WATER METER

Reading a water meter for the first time may seem confusing but once you know what you are looking at it is a very simple thing to do. Water meters vary – some have numbers and clocks, others only have numbers. The meters generally reads from left to right – black digits show the kilolitres (1,000 litres) and red digits show the single litres used. Your meter may have two, three or four red numbers



TIME TO INVESTIGATE

Start monitoring?

As a class you need to locate your school's water meter(s) and record the number. This number is the starting point for monitoring your water usage from this point onwards.

Example Meter Reading

1000 Kilolitres	100 Kilolitres	10 Kilolitres	1 Kilolitres or 1000L	100 Litres	10 Litres	1 Litre	0.1 Litres
	8	6	7	5	3	0	9

Schools Meter Reading

1000 Kilolitres	100 Kilolitres	10 Kilolitres	1 Kilolitres or 1000L	100 Litres	10 Litres	1 Litre	0.1 Litres

When the water meter is first installed it starts to collect data based on the water passing through it. The water meter is not reset, which means you are reading the total amount of water that has passed through since its installation.

INTERVIEWING SCHOOL STAFF

Let's Talk?

It's important to meet with decision makers at your school to see if any procedures or programs have been put in place to help manage your school's water usage. Principal, teachers, cleaners, kitchen staff and the facilities team are all good people to ask about how the school is using water. The information gathered by interviewing different people at school will help to provide a story or context to your school's water usage.

Who are you interviewing?

- **Principal**
- **Kitchen/Canteen**
- **Facilities/Maintenance**
- **Cleaners**
- **Teachers**

In small groups you will be designated one person/group to interview. Once you have collected information from the interview you will be able to share your findings with the class.

As a group, the class will now be armed with the information needed to identify areas of water loss and conservation within the school.

This will be key in developing a school water management plan.

INTERVIEW QUESTIONS

School Principal Interview Questions	Response
1. How do we report a leaky tap and bubblers if we find them?	
2. Does our school have a water managment plan?	
3. What areas of the school do you think use the most water?	
4. What is something teachers could do to conserve water?	
5. What do you think would be the best thing for the school to do in conserving water?	
6. How often does our school lease out space for community and business functions that use water?	
7. Are there functions on the weekends at school that require water?	

Kitchen /Canteen Staff Interview Questions	Response
1. What tasks use the most water in the kitchen?	
2. Do we have any known water saving devices in use?	
3. What would be something that could lower our water consumption in the kitchen?	
4. What time of the day does the kitchen use the most water?	
5. How do we wash dirty plates, cups etc at school?	

Facilities/Maintenance Interview Questions	Response
1. What locations do we water or hose down at school?	
2. What time of the day do we water plants and/or grass?	
3. What is our method in watering ovals?	
4. Do we use timers when watering?	
5. Is there any water saving devices on fixtures? E.g. aerators, dual flush, etc.	
6. Does the school have water tanks? If so, are they pumped into the school or unplumbed for use outside only?	
7. Do we have drought-tolerants plants at school?	
8. Do we use mulch in garden beds?	




Cleaners Interview Questions	Response
1. Which areas of the school require the most amount of water when cleaning?	
2. When using the hose, does it have a trigger nozzle on it?	
3. Do we use a washing machine at school?	
4. Is the water that is used to clean outside areas potable (drinkable)?	
5. Are there methods in place to help you use less water during cleaning?	

Teacher Interview Questions	Response
1. Have teachers been shown ways to conserve water at school?	
2. What areas of the school do you think use the most water?	
3. Are there any wet spaces for art and industrial subjects at school?	
4. Does our school have commercial kitchens for teaching students?	
5. Are there any projects students could do to help conserve water at school?	
6. Do we have any agriculture plots that require water?	

Students’ Choice: Students can create five of their own questions to ask a staff member at school about water usage.

Students’ Choice Interview Questions	Response

Mardi Dam

SCHOOL FACILITIES AUDIT

Location: ______________________________

Water Device	Number of devices	Number broken /not working	Number dripping or leaking	Number of Water efficient devices
Toilets single flush				
Toilets dual flush				
Urinals				
Taps				
Bubblers				
Zips/hot water heaters				
Hoses				
Sprinklers				
Other				
Total				

Class Results Combined

Water Device	Number of devices	Number broken /not working	Number dripping or leaking	Number of Water efficient devices
Toilets single flush				
Toilets dual flush				
Urinals				
Taps				
Bubblers				
Zips/hot water heaters				
Hoses				
Sprinklers				
Other				
Total				

What does a drip cost? more than just a drop in a bucket

WHAT DOES A DRIP COST?

A dripping tap may seem like a drop in a bucket when it comes to water loss at school. In fact, if your school has five dripping taps that drip five times a minute, over a year the total water lost is 3,285 litres! That is equivalent to filling up 23 red rubbish bins every year.

So, let's look at how to calculate how much water a dripping tap can lose over a year.

What you need

1) 10mL graduated cylinder
2) Stop watch
3) Calculator

Locate a tap that is dripping or has a slow leak. Place the graduated cylinder under the drip/leak and start the stop watch. After 1-minute record how many millilitres of water you collected. Write down this number in section "A" in the table below. If you have no leaky taps at school that is great. If you want to try this experiment to see how much water is potentially lost from dripping/leaky taps, allow a tap to drip slowly and record your data.

Dripping Tap Example

Drip Rate	A ml in 1 minute	B ml in 1hr (A x 60)	C ml in 1 day (B x 24)	D Litres in 1 day (C ÷ 1000)	E Litres in 1 year (D x 365)	F Number of dripping taps	Litres lost in 1 year (ExF)
Slow	2ml/min	120mls/hr	2,880mls/day	2.88litres/day	1051.2litres/yr	1	1051.2litres/yr
Fast							

Dripping Tap Activity

Drip Rate	A ml in 1 minute	B ml in 1hr (A x 60)	C ml in 1 day (B x 24)	D Litres in 1 day (C ÷ 1000)	E Litres in 1 year (D x 365)	F Number of dripping taps	Litres lost in 1 year (ExF)
Slow							
Fast							

SCHOOL WATER USE ACTION PLAN

An Action Plan is designed based on your findings to make effective changes at your school which will help to conserve water. The table below allows you to put in your findings with suggestions on where, what, how and who can help fix these issues. Take some time as a class to go over your School Water Audit Totals and Interviews to help guide you in this process.

Location	Water Fixture	Water issue (ie. Dripping tap)	What can be done?	Who can fix the problem?
e.g. Boys toilet	*Both sinks*	*Cannot turn off the water completely in both.*	*A plumber can fix the taps so they turn off completely*	*Facilities/maintenance*

WATER ACTION PLAN REPORT

Date:

Name of School:

Number of Students/teachers:

Total water usage (water bill):

Avg Daily Water Use:

Number of broken/dripping/fixtures:

Findings from your Water Action Plan

1. What areas of the school do students and teachers use the most water?

2. What are some things that can be done immediately to improve the school's' water usage?

3. What are some things that can be done to use less water at school?

4. What are long term improvements that could be done to use less water at school?

5. One suggestion that you think would best help the school in its water usage?

Implementation of your Water Action Plan:

Now is a perfect time to utilise the results from the water audit to design a plan for your school. As a class you will create short- and long-term plans that address your findings from your water audit. This will provide your Principal with viable options in making your school more water efficient.

Monitoring the success of your Water Action Plan:

Once your Water Action Plan is in place and your school has implemented some immediate changes to help save water, you can monitor your school's usage over the next month to see how it compares to the previous month by re-examining the water meter and bill.

WATER ACTION PLAN PROPOSAL

Date:

Class:

Teacher:

Reasoning for a Water Action Plan:

Water Audit findings:

Implementing immediate changes:

Items	Locations

Potential Water Savings

Items Fixed/Changed

Amount of Water Saved

Water Action Plan Short Term Goals:

Water Action Plan Long Term Goals:

Student Signatures:

Teacher Signature:

Principal Signature:

STAGE 3 SCIENCE

Drain or not to drain?

FOCUS AREA- Digital Technologies

Outcomes explored

A student:

- Plans and uses materials, tools and equipment to develop solutions for a need or opportunity ST3-2DP-T

Skills Focus

- Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships
- Employ appropriate technologies to represent data
- Compare data with predictions
- Present data as evidence in developing explanations

Content:

- Using and Interpreting Data

Content focus

Students:

- Develop knowledge and understanding of project management
- Learn abstraction and the relationship between models and real-world systems they represent

Australian Syllabus Links:

- ACTDIK015
- ACSIS090
- ACSIS107
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- 0ACSIS221

STAGE 3 MATHS

Drain or not to drain?

FOCUS AREA - Whole Numbers 2

Outcomes explored

A student:

- Gives a valid reason for supporting one possible solution over another MA3-3WM

Content focus

Students:

- Interpret integers in everyday contexts, eg temperature

Australian Syllabus Links:

- ACMNA124

Drain or not to drain

FOCUS AREA - Data 1

Outcomes explored

A student:

- Gives a valid reason for supporting one possible solution over another MA3-3WM
- uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables MA3-18SP

Content focus

Students:

- Pose questions and collect categorical or numerical data by observation or survey
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- Describe and interpret different data sets in context

Australian Syllabus Links:

- ACMSP118
- ACMSP119
- ACMSP120

DRAIN OR NOT TO DRAIN?

After heavy rain you may have noticed large standing pools of water on the grass that seem to take forever to absorb into the ground. Or perhaps you have been surprised to feel dry ground despite recent rain. What might be the common thread in these two situations? Soil!

The Central Coast has a variety of soil texture, each with their own water infiltration rates and water holding capacity.

Soils with high water infiltration rates help the environment by reducing how much water runs over the land surface, causing erosion and transporting things like rubbish and chemicals into our waterways. Water that infiltrates into the soil can travel underground into our waterways, entering through the banks and streambed after natural filtration. Rain that infiltrates into the land also helps to replenish underground water sources called aquifers.

Soils with a high-water holding capacity can help the environment by holding onto the water for longer periods of time. Just like a sponge, the soil holds the moisture and allows plants ample time to access the water for photosynthesis.

In this activity students will identify different soil textures found at their classmates' homes on the Central Coast. Students will determine soil textures by measuring the composition using a mason jar experiment and then measuring the water holding capabilities of soil. There are 12 main textures of soils that can be present in the Central Coast and students will learn the why soil is a very important component of the water supply system.

Understanding the characteristics of different soil textures on the Central Coast will provide a better understanding of why areas may be flood prone, how rain can make its way to creeks, streams and aquifers and why certain soils are better for growing plants.

DRAIN OR NOT TO DRAIN EXPERIMENTS

This activity involves three experiments to give students a better understanding of the different textures of soil found in the local area.

The experiments require soil samples which can be collected from different sites around the school, or students can bring samples from around their house. We need two full cups from each sample site. Remember to write the location on each sample.

Mason Jar Soil (Experiment One)

Equipment needed:

- One cup of soil from the homes of the three volunteer students
- One 500ml mason jar per soil sample
- Ruler
- Colander
- One tablespoon of powdered dishwashing detergent
- Baking paper

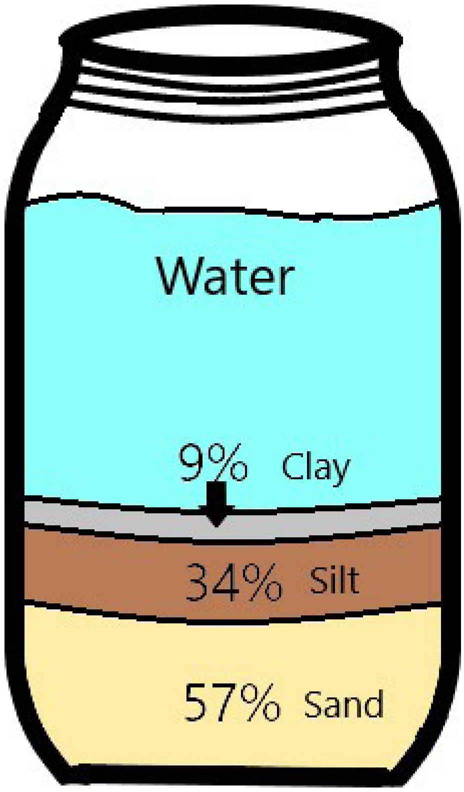
Mason Jar Experiment

- Pour soil sample through colander to remove any leaves or large debris. Catch the soil under the colander using baking paper and pour into mason jar
- Fill the rest of the mason jar with water almost to the top. Leave a 2cm gap of air under the lid
- Add one tablespoon of powdered dishwashing detergent to the water. This helps to separate the soil layers that will form in the jar
- Put the lid on the jar and shake vigorously for two minutes
- Leave the jars on a level surface for at least one full day
- The soil will settle into different layers; sand, silt and clay. Mark a line on the jar between each layer
- Use a ruler to measure each layer and record on the data sheet provided
- Repeat this process for each soil sample

Procedure

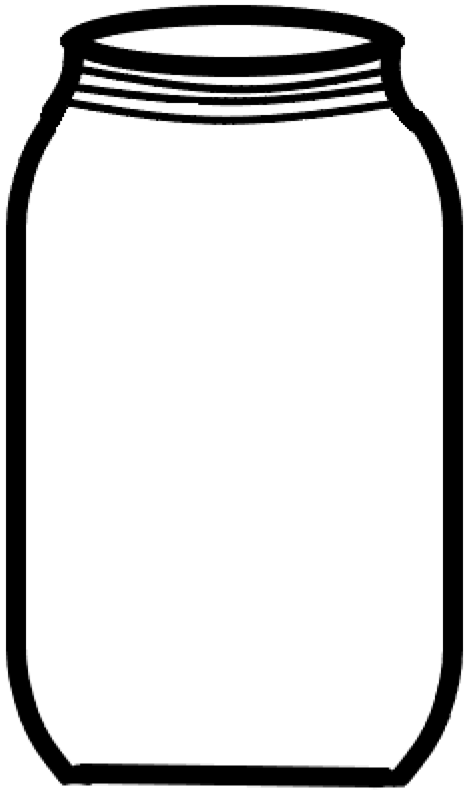
- Use the results from your Mason Jar Soil Layers experiment to fill in the Soil Texture Triangle Data table
- On the bottom side of the triangle, mark the number that correlates to the percentage of sand in your mason jar
- On the left side of the triangle, mark the number that correlates to the percentage of clay in your mason jar
- On the right side of the triangle, mark the number that correlates to the percentage of silt in your mason jar
- Use a ruler to draw in the lines on the Soil Texture Pyramid where sand, silt and clay intersect. The lines should follow the angle of the numbers
- Find the point where the three lines cross over - this tells you the soil texture for that soil sample
- Repeat for each soil sample

MASON JAR DATA SHEET



Soil Layers Data Example

	sand	silt	clay	Total
Layer thickness (mm)	33mm	20mm	5mm	58mm
%of total sediment	57%	34%	9%	100%



Student Soil Layers Data

	sand	silt	clay	Total
Layer thickness (mm)	___mm	___mm	___mm	___mm
%of total sediment	___%	___%	___%	___%

Table 1. Student Mason Jar Data

Draw in the layers as observed in your mason jar.

Label the layers of Sand, Silt and Clay

DETERMINING SOIL TEXTURE

Soil Texture Triangle Data Example

Sand	57%
Silt	34%
Clay	9%
Soil texture	Sandy Loam

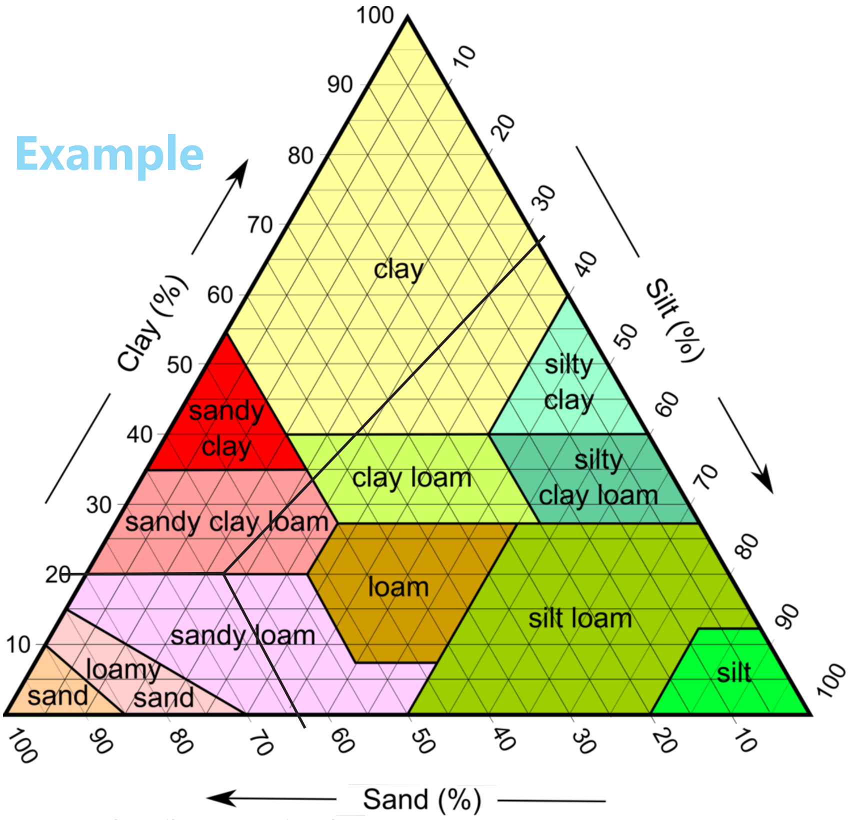


Figure 1. Example Soil Texture Triangle

Student Soil Texture Triangle Data

Sand	___%
Silt	___%
Clay	___%
Soil texture	

Table 2. Student Soil Type

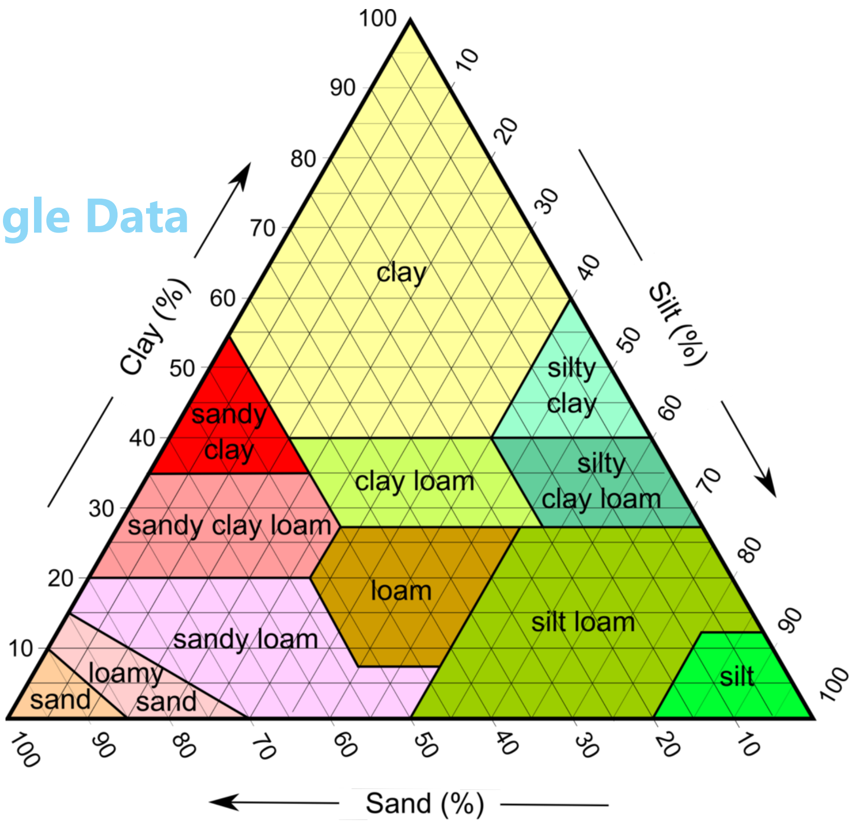
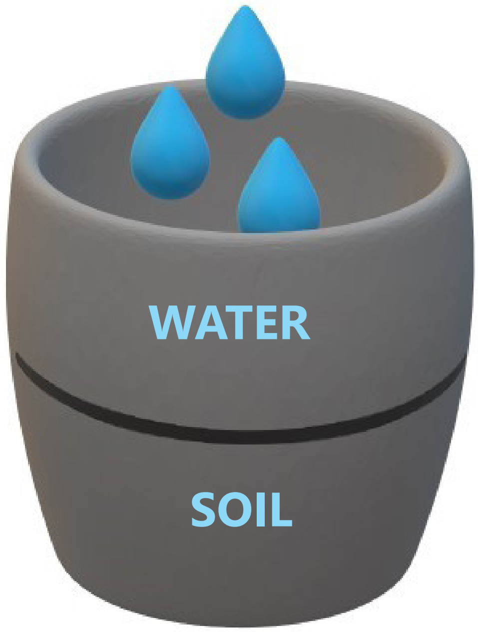


Figure 2. Student Soil Texture Triangle

SOIL DRAINAGE



Equipment needed:

- One cup of the same soil used in the Mason Jar Soil experiment
- One clear plastic cup with five small holes punched into the bottom
- One clear plastic cup with NO holes
- One 100ml graduated cylinder
- One piece of mesh or filter paper to fit the bottom of the cup

Procedure:

- Label the cup (with holes) with the location and soil texture of the sample as determined from the soil texture triangle experiment.
- Place the mesh or filter paper into the bottom of the cup with holes. This will stop the soil from falling through the holes
- Pour the cup of soil into the cup with holes
- Fill the graduated cylinder with 100ml of water
- One student can hold the cup with holes above the empty cup with no holes. Another student can pour the 100ml of water onto the soil
- Wait for two minutes while water drips into the cup below
- Pour the collected water into the graduated cylinder to measure
- Record your results on the data sheet provided

SOIL DRAINAGE DATA SHEET

1. What is the AIM of your experiment? (What are you trying to find out?)

What soil texture did you use in the experiment – (Sandy Loam, Sandy Clay, Silt)?

Soil texture:

2. How much water did you add to the soil?

A = mL of water

3. How much water drained through?

B = mL of water

4. Calculate how much water remained in your soil.

A - B = mL of water

5. Now copy from the board the combined results of the experiment for the whole class.

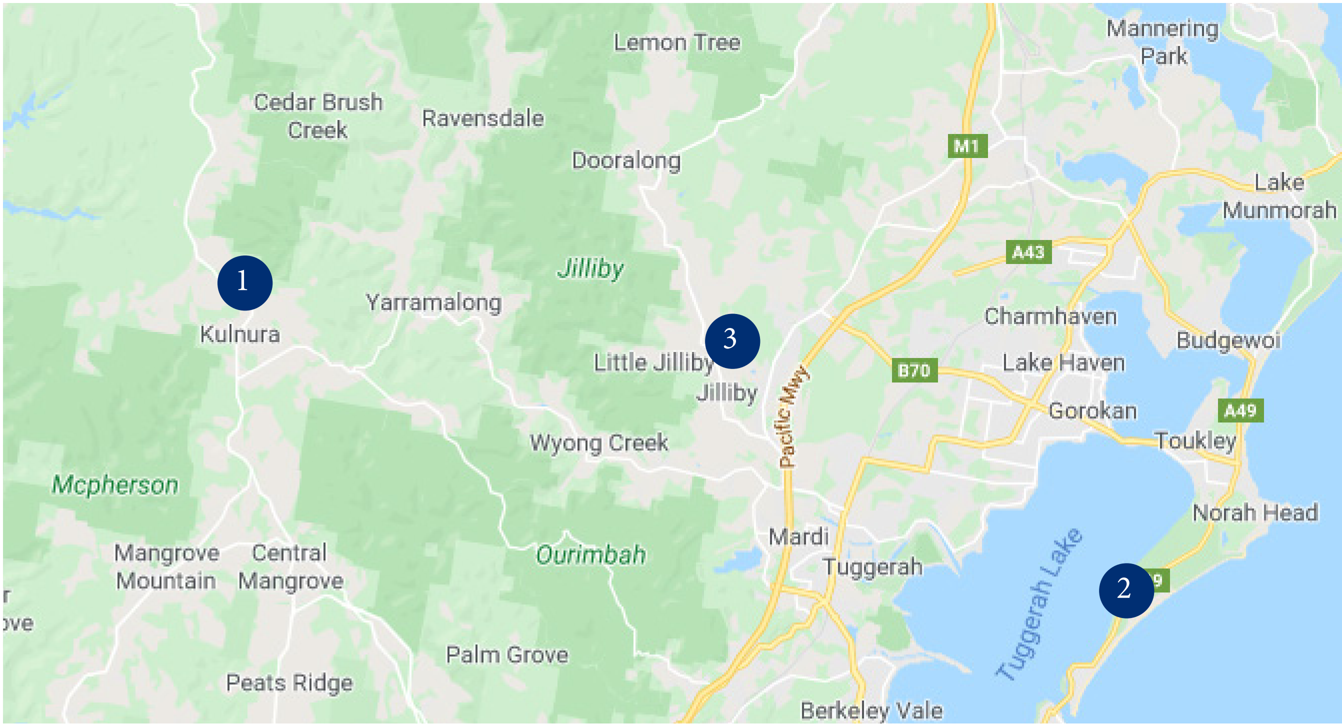
		Volume of water (mL)		
Soil texture	Soil location	Water added to the soil (A)	Water drained from soil (B)	Water held in the soil (A-B)
		100 mL		
		100 mL		
		100 mL		

Table 3. Water drained vs held

SOIL DRAINAGE DATA SHEET

6. What is the conclusion for the class experiment?
(What did your class find out about the drainage of different soils in this experiment?)

7. Let's look at the soil composition from three locations across the Central Coast. Answer the questions based on the conclusion from your own class experiment.



Location 1 Kulnura Area

Soil depth	Clay %	Silt %	Sand %
0-100cm	+50%	5-20%	30-45%

Location 2 Wyrrabalong National Park

Soil depth	Clay %	Silt %	Sand %
0-100cm	0-5%	10-15%	+85%

Location 3 Jilliby area

Soil depth	Clay %	Silt %	Sand %
0-100cm	25-30%	10-25%	50-60%

Table 4. Location Soil Data

In which location would water drain the easiest?

In which location would water drain the least effectively?

Which location presents the best conditions for water drainage?

DRAIN OR NOT TO DRAIN?

Teacher Debrief Q&A Ideas

1. **What soil texture would be best for plant growth?**
   Loamy soils are best for plants as they can hold water which gives the plant roots time to absorb the water they need. Many plants find it hard to grow in sandy soils as the water passes through too quickly. Many soils also find it hard to grow in clay soils as the water cannot penetrate the surface of the clay. However, some plants have adapted to thrive in soils that are high in sand or clay.
2. **Why would it be important to understand how different soils interact with water?**
   If you have a garden or farm, or a planning to build a park or sporting field; the soil is a very important thing to consider. Having proper soil for drainage is important so parks and fields are not flooded when it rains and having the soil that can hold onto water is important when trying to grow fruits, vegetables or crops.
3. **How does the soil impact our water supply system on the Central Coast?**
   The soil can directly impact our water supply system in a few different ways. If water can infiltrate the soil, water then can make its way to underground aquifers or enter into creeks and rivers through banks and beds. This process also provides a natural filtration system. Soils that don't allow water to infiltrate can quickly move water over the surface of the land which can fill creeks, rivers, and dams but can also create flooding.
4. **If you wanted to create a pond or dam which soil would be best to use and why?**
   Clay soils would be the best to use when creating a pond or dam as the clay creates a barrier to contain the water. If your soil was loam or sand the water would drain out very quickly and the pond or dam would dry up.
5. **Did all the student soil samples turn out to be the same texture of soil or were they different? What were the main differences between the soils sampled and how does this correlate to the location they came from?**
   Most likely the soils may have slightly different percentages of sand, silt, and clay. Students may find that the soils were similar if they all came from the same region. Try using a map to compare the different soil sample sites. Try collecting samples from the beach, bush, oval or garden for comparison and to test different theories.

Mangrove Mountain Dam wall

STAGE 3 SCIENCE

The Drip Trip

FOCUS AREA - Digital Technologies

Outcomes explored

A student:

- Plans and uses materials, tools and equipment to develop solutions for a need or opportunity ST3-2DP-T

Skills Focus

- Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships
- Employ appropriate technologies to represent data
- Compare data with predictions
- Present data as evidence in developing explanations

Content focus

Students:

- Develop knowledge and understanding of project management
- Learn abstraction and the relationship between models and real-world systems they represent

Content:

- Using and Interpreting Data

Australian Syllabus Links:

- ACTDIK015

The Drip Trip

FOCUS AREA - Whole Numbers 2

Outcomes explored

A student:

- Gives a valid reason for supporting one possible solution over another MA3-3WM

Content focus

Students:

- Interpret integers in everyday contexts, eg temperature

Australian Syllabus Links:

- ACMNA124

STAGE 3 MATHS

The Drip Trip

FOCUS AREA - Data 1

Outcomes explored

A student:

- Gives a valid reason for supporting one possible solution over another MA3-3WM
- uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables MA3-18SP

Content focus

Students:

- Pose questions and collect categorical or numerical data by observation or survey
- Constructs displays, including column graphs, dot plots and tables, appropriate for data type with and without the use of digital technologies
- Describe and interpret different data sets in context

Australian Syllabus Links:

- ACMSP118
- ACMSP119
- ACMSP120

THE DRIP TRIP

Supplying clean drinking water to the Central Coast community is very important with an ever-growing population and businesses in the area. Dams, rivers, creeks and weirs all provide water to either Somersby or Mardi Water Treatment Plant to be treated and then distributed to many reservoirs around the Central Coast. Mangrove Creek Dam is the largest dam on the Central Coast with a maximum capacity of 190,000 million litres of water when it's full. Mardi Dam is the next largest dam with a capacity of 7400 million litres and Mooney Mooney Dam holds 4900 million litres. The Central Coast on average requires about 80 million litres of water a day to meet the demand of the community and businesses. Water coming out of taps at school or home has a story to be told about the journey from rain to potable water. This activity will follow the various pathways water travels through the Central Coast Water Supply System.

Mardi Dam

Dam Depth vs Surface Area Experiment

Dams can vary in size, shape and depth depending on topography and geology of the chosen area. A dam's main purpose is to hold water. 'Dams can vary in depth and surface area. Could there be any benefits to having a deep dam with small surface area? What about a dam that has a large surface area but is shallow? This experiment models two different dams which hold the same volume of water, but the surface area and depth of each dam differs.

Items needed for this experiment:

- Thermometer
- Two pieces of black paper
- One clear **tall and narrow** container that can hold 200mL
- One clear **shallow and a wide** container that can hold 200mL
- Graduated cylinder 200mL capacity

Method:

- Cut out a black piece of paper and attach it to the bottom of each container
- Measure exactly 200mL of water into each container
- Use a thermometer to record the temperature in each container
- Place the containers of water in direct sunlight for 48 hours
- After 48 hours, record the temperatures again
- Carefully pour remaining water from each container into the graduated cylinder and measure volume. Record on data sheet provided

Dam depth vs surface area Experiment

Example results

Container	Large Surface Area Shallow depth		Small Surface Area Deep depth	
Date (day/month)	1/12	3/12	1/12	3/12
Temperature (°C)	20°C	28°C	20°C	23°C
Volume (ml)	200ml	110ml	200ml	170ml

Table Shallow vs Deep Dam

Student Results:

Container	Large Surface Area Shallow depth		Small Surface Area Deep depth	
Date (day/month)				
Temperature (°C)				
Volume (mL)				

Conclusion

BUILD THE CENTRAL COAST WATER SUPPLY SYSTEM

A dam is a single component of the Central Coast Water Supply System and there are many other important components to explore. How do dams, weirs, pipelines, pump station, reservoirs and water treatment plants all work in harmony to provide the 80 million litres of water required every day on average for the Central Coast? Let's make a simple model of the water supply system of the Central Coast to find out more.

Items required

- Graduated cylinder
- A small container of water
- Sticky Tape
- Dry erase texters
- Butcher paper, 1x1 m^2
- Two milk caps
- One clear cup that can hold 200ml
- A small bucket of stones/rocks
- Three soda caps
- two coffee filters
- 20 bendable straws
- Three small pump spray bottles
- Eye Dropper

Teacher Pre-Setup:

Cut a piece of butcher paper into a 1x1m^2 for the student map, or sticky tape sheets of paper together to make the required size.

Using Example 1. Student Map as your template draw the map using a blue texta for the water features.

a. Mangrove Creek Dam, Wyong River and Ourimbah Creek and label

b. Mardi Dam, Mooney Mooney Dam Mangrove Creek Dam

c. Tuggerah Lake and label

Question marks are added to the map where objects are located. Use Example 1. Student Map as your template in this process.

a. Dams, weirs, reservoirs and pump stations are represented as question marks on the map

There may be more than one object located at a question mark on the map. Example 2. Teacher Map is a key that has all the objects labelled and placed in the correct locations on their map.

Students will have information cards and objects which will be placed onto the map. Make sure the objects are labelled prior the activity starting.

a. 200ml clear cup as "Mangrove Dam".

b. Two milk caps representing "Mardi and Mooney Mooney Dam".

c. Three soda caps representing reservoirs "Tuggerah 2, Kanwal and Kariong 2".

d. Two paper coffee filters representing "Mardi and Somersby Water Treatment Plant".

e. Three small pump spray bottles as "pump stations".

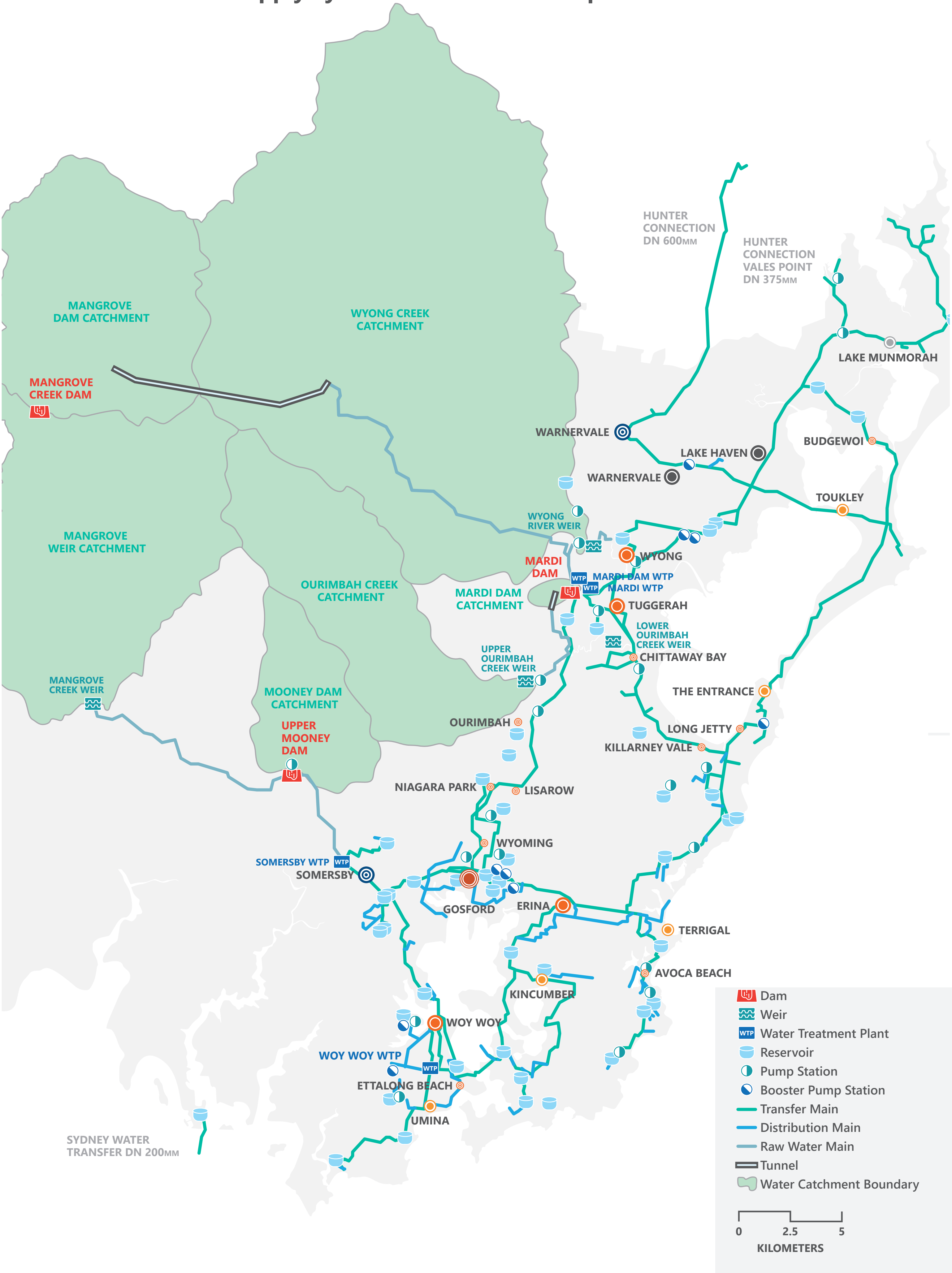
Students will be broken into four groups and provided an information card.

1. Dams
2. Weirs
3. Pipelines, Dam & River Pump Stations
4. Reservoirs & Water Treatment Plants.

Each groups information cards provides details about their specific objects along with facts. Allow the students about five minutes to look over the information prior to starting the activity.

A time line will be read by a teacher that outlines the processes involved for water to make it's way from Mangrove Creek Dam to homes, schools or businesses in the Central Coast. The bolded headings are to read by the teacher which will prompt students to place their specific objects on the map.

Central Coast Waster Supply System Infrastructure Map



How water moves on the Central Coast

1. There are three dams on the Central Coast which hold water for future use. These three dams are?

a. Students place their three dams and provide facts about each one.

2. Very similar to a dam are weirs. Weirs are structures constructed in creeks and rivers to raise the water level slightly. There are three weirs on the Central Coast located on three rivers or creeks. Where on the map are the weirs located?

a. Students place the three weirs on the map and provide information.

3. Water is collected from creeks and rivers and sent to dams for storage or to water treatment plants for treatment. Pump stations are built slightly upstream from weirs to take advantage of the increased water level. Where do pump stations belong on the map?

a. Students place the three main pump stations and provide information.

4. Infrastructure such as pipelines is vital for sending water collected from dams, rivers and creeks. Pipelines are a very important part of the water supply system in providing water efficiency and security when transporting water to the region. Where might pipelines be needed in the Central Coast Water Supply System?

a. Students will need to connect, pump stations, weirs and dams to each other using straws as pipes.

i. Lower Mangrove Weir Pump Station to Mooney Mooney Dam

ii. Lower Wyong River Weir Pump Station to Mardi Dam

iii. Ourimbah Creek Weir Pump Station to Mardi Dam

iv. Mardi Dam to Mangrove Creek Dam (special high lift pump to sends water up to Mangrove Dam)

5. Water entering into dams provides a supply of drinking water for the region. Before water can be used by the community for consumption the water needs to be treated. There are two water treatment plants on the Central Coast that provide clean drinking water. Where are they located?

a. Students place two water treatment plants on the map and provide facts for each location.

6. Water can also be directly pumped in to Somersby Water Treatment Plant and bypass the Mooney Mooney Dam. Place the pipeline that bypasses Mooney Mooney Dam and goes directly to Somersby Water Treatment Plant.

a. Students will add a pipeline that bypasses Mooney Mooney Dam. The pipeline will reconnect on the other side of the dam on its way to Somersby Water Treatment Plant.

7. Once water has been treated its then sent to three main reservoirs on the Central Coast. Where are they located?

a. Have the students place their three reservoirs on the map.

b. 'Have students connect the water treatment plants with straws along with providing facts about the reservoirs.

i. Somersby Water Treatment Plant to Kariong Reservoir 2

ii. Kanwal to Mardi Water Treatment Plant

iii. Tuggerah 2 to Mardi Water Treatment Plant

8. Once water enters the reservoirs it is ready to be used for public consumption. When reservoir levels drop its sends a signal to the Water Treatment Plants that water is required. This starts the the process again with pumping water from the dams into the treatment facilities to meet the demand.

a. Students will place straws coming out of the reservoirs. To indicate where water going to water going to the community. Students can draw houses or a town at the end of the straw coming from the reservoirs to demonstrate where the water ends its journey.

9. How much water do our reservoirs and dams hold?

a. Using a graduated cylinder and an eyedropper, you can add the correct amount of water to each location to emphasize the holding capacity discrepancy.

i. Mangrove Creek Dam -190ml (3,800 drops)

ii. Mardi Dam- 7.4ml (148 drops)

iii. Mooney Moony Dam – 4.6 ml (92 drops)

iv. Kariong 2 Reservoir – 1 drop

v. Tuggerah 2 Reservoir – >1 drop

vi. Kanwal Reservoir – >1 drop

vii. Central Coast Daily Average Usage >2 drops

1 drop = 50,000,000 litres of water in the real world.

Supplemental Information on the Central Coast Water Supply System:

The Central Coast Water Supply System can also draw water from Borefields in Woy Woy during drought conditions. The underground aquifer can help to supplement water supply demands on the Central Coast and act as a safety net when water needs increase.

The Hunter Connection is a 31km pipeline that allows water to be transferred from the Central Coast to the Hunter Region. Water transfer between the regions may change due to restrictions during drought, but it allows water to be sent both ways when there is an abundance in one region. This pipeline can provide up to 33 million litres a day. The Kanwal reservoir is the terminating point for the pipeline into the Central Coast.

There are over 50 reservoirs spread-out on the Central Coast that provide water to the community. Water is sent from water treatment plants to the three main reservoirs on the Central Coast which can send water to smaller reservoirs in the area when water is needed depending on the demand. When every reservoir is full, the total volume is approximately 400 million litres of water. This would be enough water to supply the entire Central Coast for about five days.

All the dams, reservoirs, pump stations require pipeline. There are over 2,000km worth of pipelines throughout the Central Coast allowing water to be moved around to meet the needs of the community.

The Central Coast has eight sewage treatment plants along with eight recycled water treatment plants that can take wastewater and recycle it for non-drinking uses such as construction, road works, dust suppression and landscaping.

Lower Wyong Pump Station

Student Information Cards

Dams: Group 1

Mangrove Creek Dam – 190,000 million litres

- Max depth 65 meters
- Dam wall 80 meters
- Storage Dam, stores water until needed
- Catchment area 101km²
- Water can be sent to both Mardi & Somersby Water Treatment Plant.

Mardi Dam – 7,400 million litres

- Catchment area 2km²
- Storage Dam, not fed directly by streams
- Mardi Dam receives water from Mangrove Creek Dam. Wyong River & Ourimbah Creek are pumped into Mardi Dam
- Mardi Dam also sends water to Mangrove Creek Dam

Mooney Mooney Dam – 4,600 million litres

- Catchment areas 39km²
- Oldest dam of the region
- Water is pumped to Somersby Water Treatment Plant
- 28 meter high arch dam

Items on Map

- One 200ml cup (Mangrove Dam)
- Two milk caps (Mardi & Mooney Mooney Dam)

Weirs: Group 2

Lower Wyong River Weir

- Catchment area of 355km²
- Maximum water capacity of 300 million litres
- Fishway was built to allow fish to pass through the weir and go upstream or downstream
- Located behind the Milk Factory at Wyong
- Water pumped upstream from the Lower Wyong River Weir is sent to Mardi Water Treatment Plant

Lower Mangrove Creek Weir

- Catchment area of 140km²
- Maximum water capacity of 300 million litres
- Water from Lower Mangrove Creek Wier is pumped to Somersby Water Treatment Plant.

Ourimbah Creek Weir

- Catchment area of 88km²
- Maximum water capacity of 100 million litres
- Water is pump from Ourimbah Creek Weir to Mardi Dam

Items on Map

- Small container of stones(weirs)
- The stones can be placed like a wall on a creek or river to replicate a weir.

Student Information Cards

Pipelines: Group 3

Mardi-Mangrove link

- 21km pipeline that connects Mangrove Creek Dam to Mardi Dam.
- Water is gravity fed from Mangrove Creek to Mardi Dam
- Pumps are used to move water from Mardi to Mangrove Creek Dam

Mardi to Wyong River

- 2.1km pipeline buried from Mardi Dam to Wyong River

Mardi to Ourimbah Creek

- 5.6km pipeline from Ourimbah Creek to Mardi Dam

Somersby to Lower Mangrove Creek Weir

- 14km pipeline from Lower Mangrove Creek weir to Somersby Water Treatment Plant

Dam & River Pump Stations: Group 3

Wyong River

- River water is pumped to Mardi Dam

Ourimbah Creek

- River water is pumped to Mardi Dam

Mardi Dam

- Water from Mardi Dam pumped to Mangrove Creek Dam and into Mardi Water Treatment Plant

Lower Mangrove Weir

- Water released from Mangrove Creek Dam into the weir is pumped into Somersby Water Treatment Plant or Mooney Mooney Dam

Items on Map

- 20 bendy straws (pipes)
- 3 small pump bottles (pump station)
- Sticky tape

Reservoirs: Group 4

Kanwal

- 3 separate reservoirs together equalling 38 million litres

Tuggerah 2

- When water levels in Tuggerah 2 reservoir drops to low, it will request more water to be pumped in from Mardi Water Treatment Plant
- Capacity of 40 million litres

Kariong 2

- Capacity of 50 million litres

Water Treatment Plants: Group 4

Mardi Water Treatment Plant

- Supply 160 million litres a day, that is equivalent to 64 Olympic swimming pools
- Water enters the facility through Mardi Dam

Somersby Water Treatment Plant

- 1. Supply 144 million litres a day, that's equivalent to 57 Olympic swimming pools

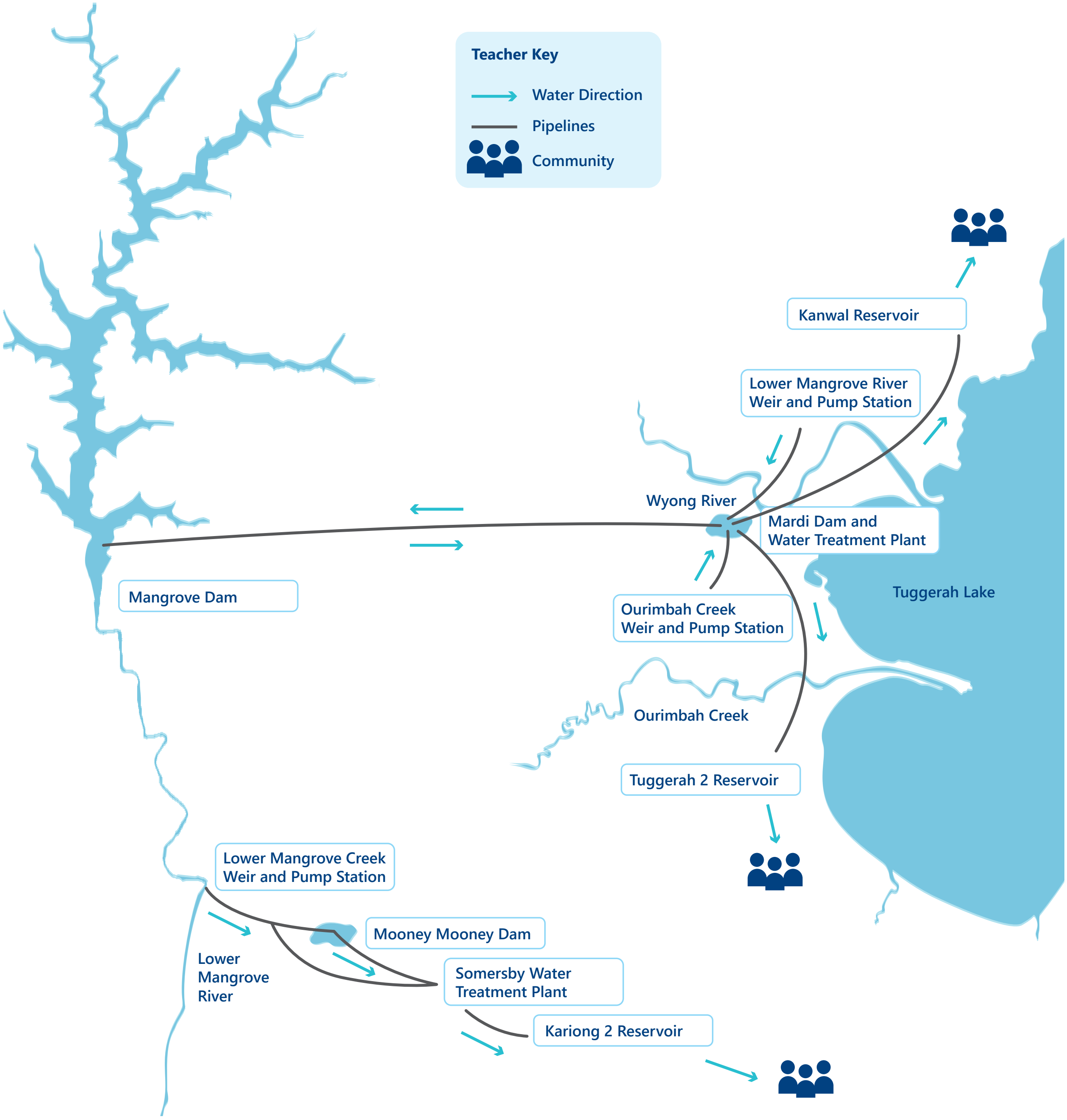
Items on Map

- Three soda caps (reservoirs)
- Black texter (labelling items)
- Two coffee filters (Water Treatment Plant)

BUILD THE CENTRAL COAST WATER SUPPLY SYSTEM

Example 1. Student Map

BUILD THE CENTRAL COAST WATER SUPPLY SYSTEM



Example 2 Teacher Map

THE DRIP TRIP

Teacher Debrief Q&A Ideas

1. **After completing the depth vs surface area experiment what do your findings indicate?**
   Having a deeper dam with less surface area helps to limit the amount of water evaporating. This is due to having cooler water temperatures by having less surface area where the sun can heat up the water. Dams in the Central Coast must account for water loss during the summer due to evaporation. When the Central Coast has hot temperatures, water is lost into the atmosphere along with consumption by the community. Having a deep dam such as Mangrove Creek Dam is one way to lessen the loss of water before it can be used by the community.
2. **Algae like to grow in warm water with plenty of sunlight. Which of the two dams may Algae be more likely to affect and why?**
   A shallow dam with a larger surface area can be a perfect situation for algae growth. Conditions that favour algae growth are warm water temperatures, direct sunlight and stratified water (no mixing of lower water with surface water). Deep dams will still have warmer water on the surface with lots of direct sunlight, but what it has in its favour is the ability to not get as warm with the deeper areas staying at a cooler temperature even during the hot summers.
3. **How many dams are on the Central Coast and put them in the correct order from largest to smallest in water capacity?**
   1. Mangrove Creek Dam -190,000 million litres,
   2. Mardi Dam -7,400 million litres,
   3. Mooney Mooney Dam – 4,600 million litres
4. **Why is it important to have Mangrove Creek Dam and Mardi Dam connected with a pipeline?**
   Having Mangrove Creek Dam and Mardi Dam connected allows water to be transported between the two locations when water is in abundance in the Wyong River or Ourimbah Creek after heavy rainfalls. The river and creek water can be pumped into Mardi Dam and then sent to Mangrove Dam. If extreme weather is expected with heavy rain, Mardi Dam can send water to Mangrove Creek Dam to make room for the upcoming rainwater to be stored. When water is needed for treatment and Mardi Dam is low, Mangrove Creek Dam can send water to Mardi Dam to meet the needs of the community.
5. **What is the purpose of weirs in creeks and rivers?**
   Weirs are structures built in creeks and rivers that still allow water to either pass over the top or underneath while increasing the water levels slightly upstream. Water can be extracted at pump stations located on creeks and rivers where weirs have been built. Weirs also play a role in the flow of water in creeks and rivers by slowing down the flow and providing some control measures when flooding occurs downstream of weirs.
6. **What are the three main reservoirs in the Central Coast and how do they refill when the water level gets low?**
   The three main reservoirs are Kariong 2, Tuggerah 2 and Kanwal. When reservoirs become low they send a signal to the water treatment plants or other reservoirs nearby to send more water. Eventually, water treatment plants will have to start treating water to meet the demands of the reservoirs.

Succulent Garden

STAGE 3 SCIENCE

Waterwise Garden

FOCUS AREA - Digital Technologies

Outcomes explored

A student:

- Plans and uses materials, tools and equipment to develop solutions for a need or opportunity ST3-2DP-T

Skills Focus

- Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships
- Employ appropriate technologies to represent data
- Compare data with predictions
- Present data as evidence in developing explanations

Content:

- Using and Interpreting Data

Content focus

Students:

- Develop knowledge and understanding of project management
- Learn abstraction and the relationship between models and real-world systems they represent

Australian Syllabus Links:

- ACTDIK015

STAGE 3 MATHS

Waterwise Garden

FOCUS AREA - Whole Numbers 2

Outcomes explored

A student:

- Selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations MA3-2WM
- Gives a valid reason for supporting one possible solution over another MA3-3WM

Content focus

Students:

- Interpret integers in everyday contexts, eg temperature

Australian Syllabus Links:

- ACMNA124

Waterwise Garden

FOCUS AREA - Data 1

Outcomes explored

A student:

- Gives a valid reason for supporting one possible solution over another MA3-3WM
- uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables MA3-18SP

Content focus

Students:

- Pose questions and collect categorical or numerical data by observation or survey
- Constructs displays, including column graphs, dot plots and tables, appropriate for data type with and without the use of digital technologies
- Describe and interpret different data sets in context

Australian Syllabus Links:

- ACMSP118
- ACMSP119
- ACMSP120

HOW SMART IS YOUR GARDEN?

Water is an important resource on the Central Coast due to the increasing demand on our water supply system. One way schools can contribute is being water conscious and having a Waterwise garden at school. Gardens at schools provide habitat for local animals, holds soil to ground during windy days and also beautifies the area.

The Central Coast has very hot summers and drought is always looming due to changes in climate. The amount of water required to keep the gardens lush and green depends on a variety of components. The type of plants, soil, shaded areas and ground cover all play a factor in water efficiency of a garden. Waterwise gardens focus on having plants species that can survive with very little water which are adaptations for dry environments. Water being a resource that is vital to everyone in the Central Coast it's important to properly plan out gardens to ensure water efficiency rather than water wasting. Today's experiment will survey a garden at your school to determine if your school's garden is Waterwise or water wasting.

The key areas of focus will be:

- Leaves
- Location
- Soil/ground cover
- Watering method

Equipment needed:

- Clipboard
- Thermometer

HOW SMART IS YOUR GARDEN?

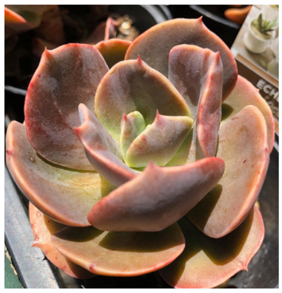
Leaves

Plants absorb water through their roots but they also lose water through their leaves. This process is called transpiration which is the flow of water from the leaves to the dryer atmosphere. This happens when the sun heats the leaves and turns the water inside the leaf into water vapour which can escape the plant. Plants have physical adaptations to limit this water loss such as:

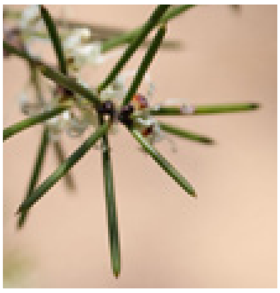
- Thick waxy leaves that limit the water loss and allows storage of water in the tissue of the leaves.
- Needle-like leaves to cut down on the surface area so they don't get as hot during the summer and reduce lose water.
- Hair like fibres that create insulation around the leaves to keep the dry wind from blowing away the humid air around the leaf.
- Leaves that are folded or curled can conserve water by not being fully exposed to the sunlight and wind thus limiting water loss.
- Leaves that are grey and silver reflect more sunlight which helps to minimize heating of leaves and water loss.

In table one below inventory all the plants in the garden based on the leaf categories. The inventory will be an important piece of data to determine if this garden is Waterwise.

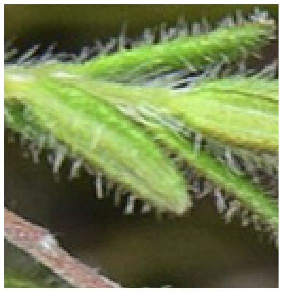
Grey and Silver leaves



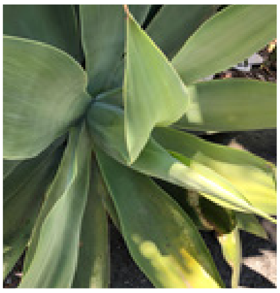
Thick waxy leaves



Needle-like leaves



Hairy leaves



Folded or curled leaves

Leaf types	Thick waxy leaves	Needle like leaves	Hairy leaves	Folded or curled leaves	Grey and sliver leaves	No leaf adaptations
Tally (individual plants						
Grand Total						

Place a tick mark in the box based on your findings from this experiment

Waterwise	**Water wasting**

HOW SMART IS YOUR GARDEN?

Shaded garden

Location

The amount of direct sunlight your garden receives impacts the water loss from the plants and soil. As temperatures increase moisture in the ground evaporates leaving less water in the soil for the plants to use. Leaves will also lose water from direct sunlight due to water turning into water vapour and escaping from the plant's leaves. Shaded areas limit direct sunlight and lessen the amount of water lost into the atmosphere. Wind can also play a significant role in water loss in gardens. When hot summer winds occur, they can pull moisture away from plants much like a hairdryer to wet hair. If gardens are fully exposed to wind and sun this can increase the amount of water loss. Having partially protected gardens will minimize the water loss due to wind and sun.

The table below has three categories where data will need to be collected and entered. Once the garden has been selected, circle the answers that best match the shade and wind options. Randomly select three different locations in your garden and record the temperature, shade and amount of protection from the wind at each location. Finally, calculate the average for your garden.

	Location 1	Location 2	Location 3	Average
Temperature (°C)				
Shade	No Shade Some shade Mostly shade	No Shade Some shade Mostly shade	No Shade Some shade Mostly shade	
Wind Protection	No protection Some protection Mostly protected	No protection Some protection Mostly protected	No protection Some protection Mostly protected	

Place a tick mark in the box based on your findings from this experiment

Waterwise	**Water wasting**

HOW SMART IS YOUR GARDEN?

Soil and Ground Cover

When water is applied to gardens the goal is to keep the soil wet for an extended amount of time so that the plants can absorb the water through their roots. The soil in gardens plays an important role in this process for retaining water. Certain types of soil can either hold the water like a sponge, let it pass through like a colander for spaghetti or some soil doesn't allow water to pass through and acts as a barrier. Having the proper type of soil in the garden beds helps to maximize the water being held for the plants to use. When trying to maximize water savings in gardens, ground cover is a vital component in achieving this. Ground cover is often added to the gardens to keep moisture in the soil by using woodchips, mulch and bark. This layer acts like a blanket that keeps the soil under it cooler which then limits how much water is lost by evaporation. Let's look to see if the soil and ground cover are doing their job.

Mulch

Use the table below to circle which soil type and ground covering exist in the garden. Complete this table and tick the box if you believe the soil and ground cover are Waterwise.

Soil	Mostly sand (water drains fast)	Mixture of sand, clay and other organic material (holds water for plants well	Clay (water doesn't absorb well)
Ground Cover	No groundcover. Exposed soil (hot soil, water loss to evaporation	Some wood chips, mulch and bark. Not completely coverered. (cooler soil under twood chips, holds some moisture	Woodchip, mulch and bark covering all the soil (cooler soild holds the moisture in soil

Place a tick mark in the box based on your findings from this experiment

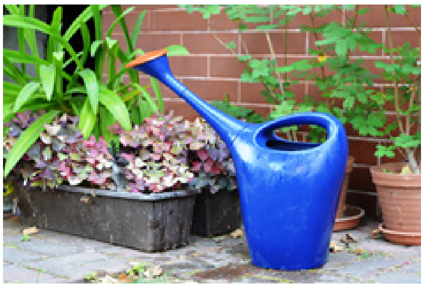
Waterwise	**Water wasting**

HOW SMART IS YOUR GARDEN?

Watering Method

Effective components of a waterwise garden thus far include; water-efficient plants, soil that holds moisture, ground covering, and location. The final part of a waterwise garden is the watering method implemented. Watering the garden every day is not necessary if you have the correct plants, soil and ground covering. A good long soaking of the soil early in the morning or at night is the best. Taking away the suns ability to heat the soil and evaporate the water before the plants can absorb it is crucial. The way a garden is watered is very important since this is the direct use of water. Having a sprinkler system spraying water everywhere is inefficient if the sprinkler is not focused on the garden. Automated irrigation systems are very effective by having water directly applied to the soil allowing the plants to slowly absorb water with less water used and lost. A hose with a nozzle or a watering can be very effective since you can water specific areas while minimizing the waste of water in areas that do not need water. Lastly, where does the water used for gardens come from? Check to see if the school is using rainwater tanks to harvest water for gardens. Collected rainwater is best since it has no chemicals added and the water is not being taken from the potable water supply. Drought conditions are always looming which means when available try to use rainwater not town water for outdoor use.

Use the table below to circle which watering method, water source and watering time is being used. Complete this table and tick the box if you believe the soil and ground cover are waterwise.



Watering Can

Watering Method	Sprinklers (lots of water used everywhere)	Automated Irrigation (watering on a timer with various slow methods of water application)	Hose with nozzle or Watering Can (water can be placed where its need)
Water Source	Town Water (drinkable water)	Rain Water (collected in rain tanks, not treated)	Grey Water (re-used wastewater)
Watering Time	Early Morning (cool time of the day)	Mid-day (warmest time of the day)	Evening (cool time of the day)

Place a tick mark in the box based on your findings from this experiment

Waterwise	**Water wasting**

HOW SMART IS YOUR GARDEN?

Experiments Results		
	Results	Waterwise or Water wasting
Leaf (plant tally)		
Shade		
Temperature	C°	
Wind Protection		
Soil		
Ground Cover		
Water Source		
Watering Time		

Table. Smart Garden Results

HOW SMART IS YOUR GARDEN?

Teacher Debrief Q&A Ideas

1. **A waterwise garden has various components to ensure water is used to its maximum potential. After completing the experiment what do you conclude about the garden examined?**
   Students will look at their results and decide if the garden they inspected is waterwise or water wasting. Students may find it to be not conclusive if the results have a mixture of both waterwise and water wasting components.
2. **What are some ways to make the garden more water efficient?**
   Analysing the results, students can select which areas need changes and provide ways to achieve a more water conscious garden.
3. **What aspects of the garden are well designed?**
   Students discuss which areas of the garden were well designed and how that impacted the garden. Also, students can compare other aspects of the garden that did not meet the standard of a waterwise garden.
4. **Why is it important to have waterwise gardens at school?**
   Schools water usage varies depending on the size of the school, but generally one of the biggest uses of water at schools is water gardens, lawns and ovals. Minimizing water loss with proper planning of ovals, gardens and lawns can save significant amounts of water annually.
5. **How can you extend this knowledge beyond school?**
   Using the same experiment at home students can explore their own gardens. Students can then provide results from the experiment to family and friends.

Experiments Results		
	Results	Waterwise or Water wasting
Leaf (plant tally)		
Shade		
Temperature	C°	
Wind Protection		
Soil		
Ground Cover		
Water Source		
Watering Time		

STAGE 3 SCIENCE

Running Dry

FOCUS AREA - Digital Technologies

Outcomes explored

A student:

- Plans and uses materials, tools and equipment to develop solutions for a need or opportunity ST3-2DP-T

Skills Focus

- Construct and use a range of representations, including tables and graphs, to represent and describe observations, patterns or relationships
- Employ appropriate technologies to represent data
- Compare data with predictions
- Present data as evidence in developing explanations

Content:

- Using and Interpreting Data

Content focus

Students:

- Develop knowledge and understanding of project management
- Learn abstraction and the relationship between models and real-world systems they represent

Australian Syllabus Links:

- ACTDIK015

STAGE 3 MATHS

Running Dry

FOCUS AREA - Whole Numbers 2

Outcomes explored

A student:

- Selects and applies appropriate problem-solving strategies, including the use of digital technologies, in undertaking investigations MA3-2WM
- Gives a valid reason for supporting one possible solution over another MA3-3WM

Content focus

Students:

- Interpret integers in everyday contexts, eg temperature

Australian Syllabus Links:

- ACMNA124

Running Dry

FOCUS AREA - Data 1

Outcomes explored

A student:

- Gives a valid reason for supporting one possible solution over another MA3-3WM
- uses appropriate methods to collect data and constructs, interprets and evaluates data displays, including dot plots, line graphs and two-way tables MA3-18SP

Content focus

Students:

- Pose questions and collect categorical or numerical data by observation or survey
- Constructs displays, including column graphs, dot plots and tables, appropriate for data type with and without the use of digital technologies
- Describe and interpret different data sets in context

Australian Syllabus Links:

- ACMSP118
- ACMSP119
- ACMSP120

RUNNING DRY

Having access to fresh water is vital for cooking food, washing clothes, bathing, drinking and for businesses to provide products and services to the community. Water in the Central Coast is harvested from rivers, creeks, dams, weirs and underground aquifers. Water is accessed in a variety of ways and one such way is groundwater bores. A groundwater bore is when you drill down into the earth to find water locked under the soil. This water is pumped out of the ground to be utilised by the community. There are approximately 870,000 groundwater bores in Australia to provide fresh water to rural and metropolitan areas. The Central Coast has groundwater bores located in Woy Woy, Mangrove Weir, Wyong Creek, Somersby, Ourimbah and Narara. The Woy Woy borefields can extract the most water out of all the borefields in the Central Coast. This location can produce up to five million litres of water a day and send it directly to the Woy Woy Water Treatment Plant as an emergency supply in case of water shortages during drought.

The Central Coast has a mixture of hard rock and sand aquifers that contain water. The quality of water depends on the source of water, how long the water has been stored underground, the quality of the water coming into the aquifer and structure type of the aquifer. This activity uses a simulation developed by The **Concord Consortium** to demonstrate how groundwater bores acquire water and the various components that can affect how aquifers gain and lose water over time.

The variables to pay attention to are rain, soil types, aquifer structure, recharging points of aquifers and consumption of the bore. The Central Coast goes through cycles of droughts or an abundance of water.

Understanding how rivers, creeks, and aquifers can be impacted by over consumption is a very important issue for water security for the community.

Figure 1 Mardi Dam

Introduction

1. Open The link to "Exploring Groundwater Movement" https://has.concord.org/groundwater-movement.html
2. The initial start-up screen will look like Figure 2 below.
3. Notice the term "well" is used in this simulation. Groundwater bore is an Australian term that is equivalent to a "well" in the USA.

Icon Key

- Refresh icon (1) – allows you to restart the program and remove all options.
- Add Well (2) – allows you to choose either flowback or non flowback well (ground water bore). We will be using a *non-flowback* well option for this entire simulation.
- Start/Stop/Reset (3) —This button will allow you to start the simulation, pause it or reset.
- Template (4) – pre-made layers to for modelling.
- Rain Probability (5) —This is the control for the rain to fall during the simulation.

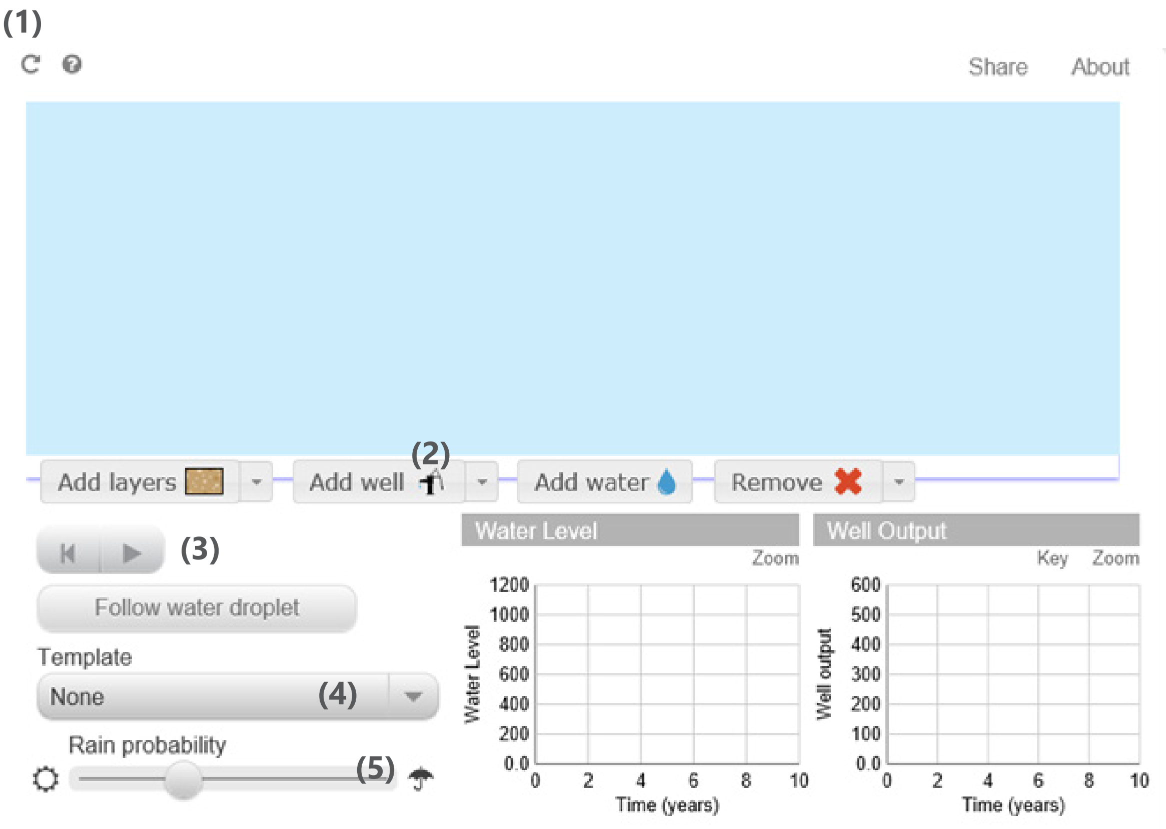


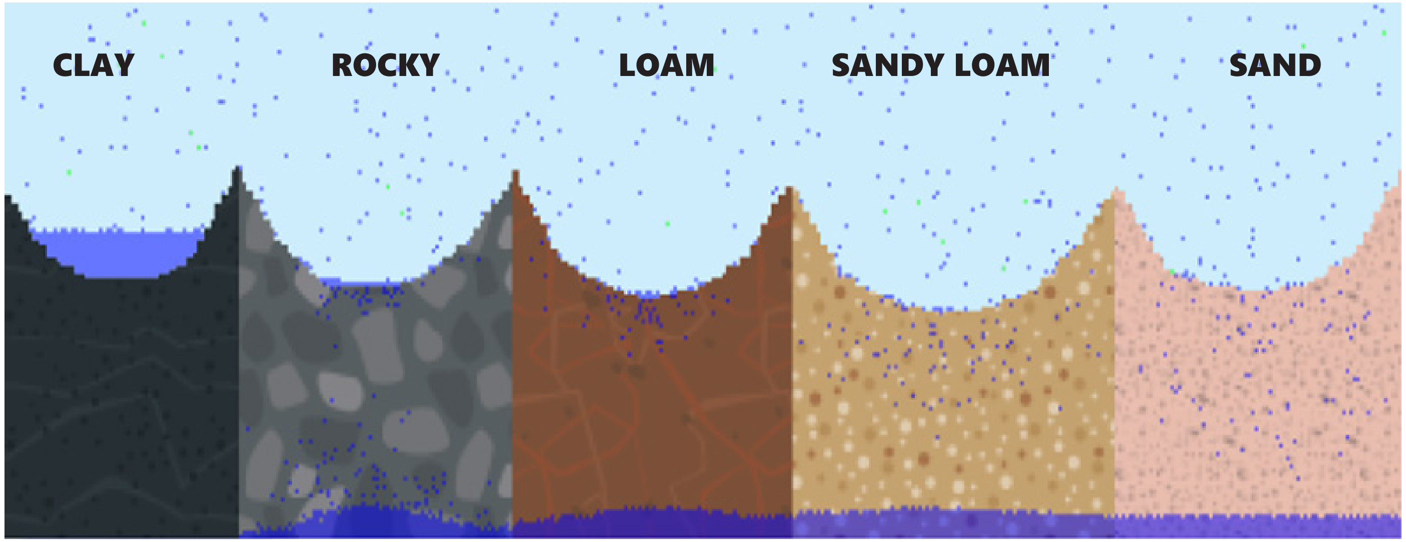
Figure 2 (Lab Licence https://github.com/concord-consortium/lab/blob/master/license.md)

RUNNING DRY

When running the simulation, first you want to understand what "permeability" is? Permeability is the ability of water to penetrate through different soil types. In the "**Template**" option select "**Compare permeabilities**". The image below shows you what the Compare permeabilities will look like.

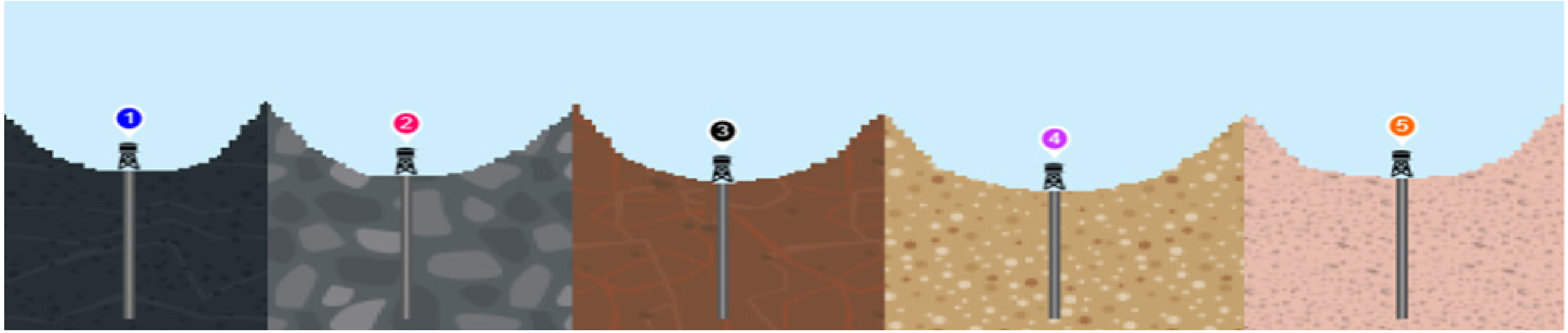
All five soil types should appear. Click on the "**start button**" and watch how water moves through the soil. Set the "**Rain probability**" dial to the middle so that a significant amount of water will fall so you can see how different soil types allow water to passes through. You will notice that the soil type on the left keeps most of the water on the surface while on the left it passes right through. The image below will provide you the names of the soil types that best match the permeabilities in the simulation.

Figure 3 Soil types and permeability



(Lab Licence https://github.com/concord-consortium/lab/blob/master/license.md)

Figure 4. groundwater bore on different soil types



(Lab Licence https://github.com/concord-consortium/lab/blob/master/license.md)

How to add a groundwater bore (well): Select "A**dd well**" tab to insert groundwater bore on the five different soil types. Choose the **"non-flowback well**" to use during this exercise. Place one groundwater bore on each soil type as shown in Figure 4. When you hold the left mouse button down when placing, you will notice it drilling down into the soil. Once you release the mouse button the drilling will stop and that is where you will be pulling water from. If you need to redo your groundwater bore just select the refresh icon and it will start the simulation over.

The two graphs represent the time in years for **Water level** and **Well Output**

-Water Level represents water on the surface. When there are large amounts of water on the surface it could indicate potential flooding. Also, it may be an area that seasonally fills to create lakes and then dries up in the hot summer months. The units of measurement are not specific, so it's just to demonstrates how surface water levels can change over time by rainfall, drainage and evaporation.

-**Well Output** (Groundwater Bore Output) will provide how productive the groundwater bore are over time. The measurements are not specific but an indication of how productive your groundwater bore pumps water. The different soil types where aquifers exist, how many groundwater bores in the area and accessing the same water source will affect individual groundwater bore output. This data will be indicated in the graph with colours matching the groundwater bores output.

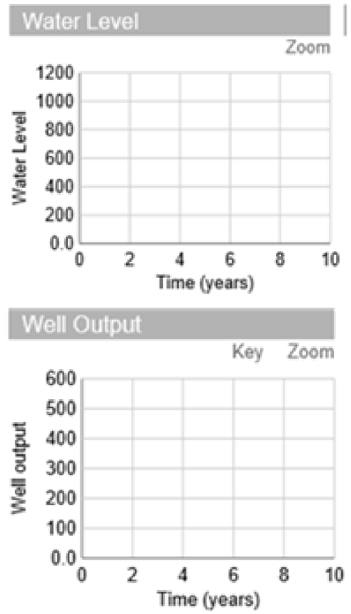
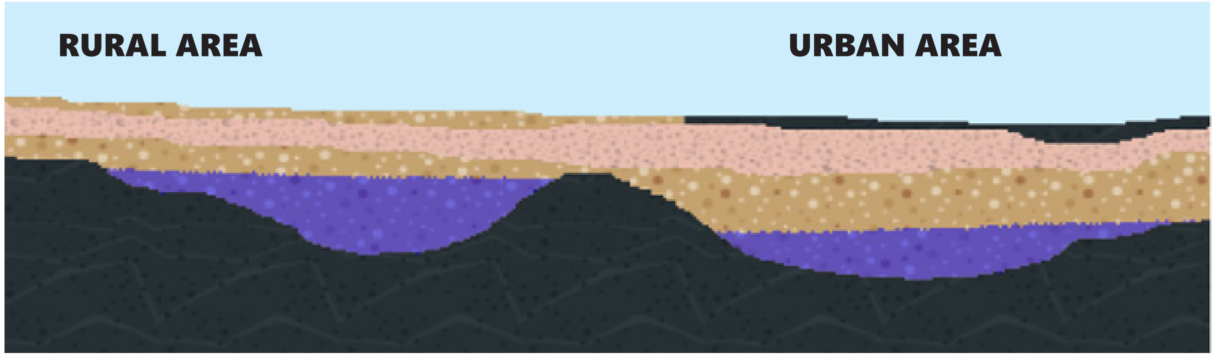


Table 1. Water level and Well Output

Figure 5 Rural vs Urban area template



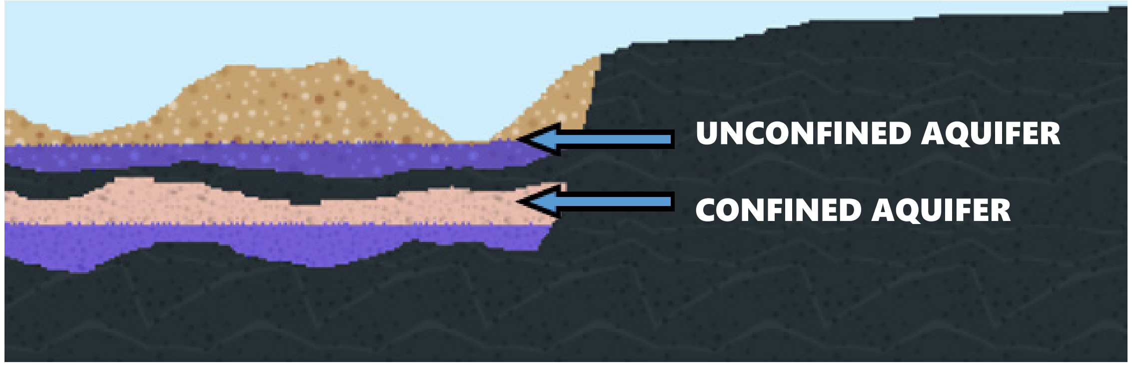
(Lab Licence https://github.com/concord-consortium/lab/blob/master/license.md)

Simulation 1

Rural vs Urban Areas:

1. Select in the "**Template**" options "**Rural vs urban areas**". This will load a premade template that has a rural area on the left and an urban area on the right. Notice that the urban area has a soil that doesn't drain well or its non-permeable on the surface.
2. Set the "**Rain probability**" to the middle of the slider bar and then start the simulation. Allow the simulation to run for three years and then pause it.
3. Observe the "**Water Level**" graph. What do you notice about the water level over the three years?
4. Use Table 2. Rural vs Urban Areas graph to copy the first three years of the simulation.
5. Add two non-flowback wells (groundwater bores) to the simulation. Place one in the Urban Area and one in the Rural area. Make sure they drill down into the underground aquifer to access the water.
6. What do you think will happen to the water level by adding two groundwater bores?
7. Start the simulation for three more years and observe the Water Level graph and the **Well** (groundwater bore) **Output** graph.
8. What changes happened to the **Water Level** graph over the next three years? Graph the results to complete a six-year cycle. Why do you think that happened?
9. Looking at the **Well** (groundwater bore) **Output** graph what happened over the three years?
10. What may have affected the groundwater bores outputs after looking at the graph?

Figure 6) Confined vs Unconfined Aquifer



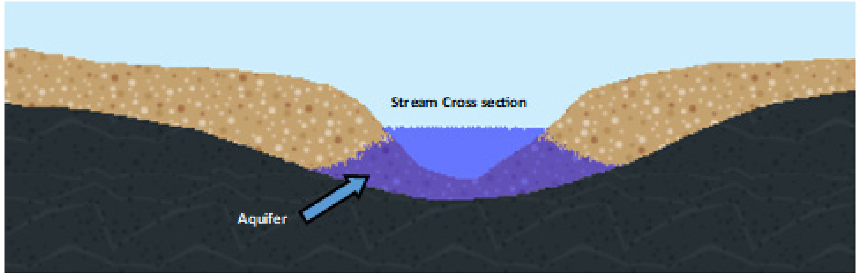
(Lab Licence https://github.com/concord-consortium/lab/blob/master/license.md)

Simulation 2

Confined vs Unconfined Aquifers:

1. Select in the "**Template**" options "**Confined vs Unconfined aquifers**". This will load a premade template that has a Confined vs Unconfined aquifer labelled below. Notice the confined aquifer has a layer above that does not allow water to pass through.
2. Set the "**Rain probability**" to the middle of the slider bar and then start the simulation. Allow the simulation to run for three years and then pause it.
3. Observe the "**Water Level**" graph. What do you notice about the water level over the three years?
4. Use Table 3. Confined vs Unconfined Aquifer graph to copy data to the first three years of the simulation.
5. Add two non-flowback wells (groundwater bores) to the simulation. Place one so that it has access to the Confined Aquifer and the second one only to the Unconfined Aquifer.
6. What do you think will happen to the water level and well (groundwater bore) output.
7. Start the simulation for three more years and observe the **water level** graph and the **well** (groundwater bore) **output** graph.
8. What changes happened to the Water Level graph over the next three years? Why do you think that happened?
9. Looking at the **Well** (groundwater bore) **Output** graph what happened over the three years?
10. What may have affected the groundwater bores outputs after looking at the graph?

Figure 7 Losing Steam



(Lab Licence https://github.com/concord-consortium/lab/blob/master/license.md)

Simulation 3

Losing Stream:

1. Select in the "**Template**" options "**Losing Stream**". This will load a premade template that has a cross-section of a stream with an aquifer below allowing water to move into the stream.
2. Set the "**Rain probability**" so that it's rarely raining and put two groundwater bores that can access the aquifer on both sides of the stream. Allow the simulation to run for three years and then pause it.
3. Observe the "**Water Level**" graph. What do you notice about stream level?
4. Use Table 4 Losing Stream Graph and copy the data for the first three years of the simulation.
5. What would the "**Rain Probability"** need to be set at for the stream to go back to its original level?
6. Not having consistent rain to fill streams could be disastrous if groundwater bores are pumping water. What changes could you make if you ran the simulation over again to lower the stress on the stream?
7. Reset the simulation and make the changes you believe could lower the stress on the stream.
8. What changes happened to the **Water Level** graph over the next three years? Why do you think that happened?
9. Looking at the **Well** (groundwater bore) **Output** graph what happened over the three years?
10. What may have affected the groundwater bore outputs after looking at the graph?

RUNNING DRY

Data Collection Graphs:

Water Level represents water on the surface. When there are large amounts of water on the surface it could indicate potential flooding. Also, it may be an area that seasonally fills to create lakes and then dries up in the hot summer months. The units of measurement are not specific, so it's just to demonstrates how surface water levels can change over time by rainfall, drainage and evaporation.

Well Output (Groundwater Bore Output) will provide how productive the groundwater bore is over time. The measurements are not specific but an indication of how productive your groundwater bore pumps water. The different soil types where aquifers exist, how many groundwater bores in the area and accessing the same water source will affect individual groundwater bore output. This data will be indicated in the graph with colours matching the groundwater bores output.

Simulation 1. Rural vs Urban Areas

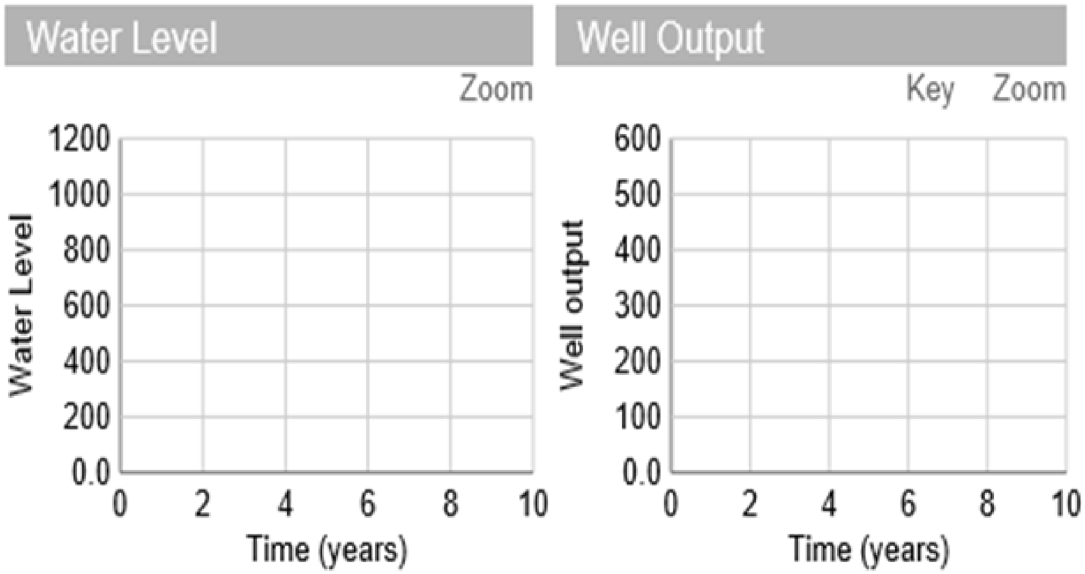


Table 2. Rural vs Urban Areas

RUNNING DRY

Data Collection Graphs:

Water Level represents water on the surface. When there are large amounts of water on the surface it could indicate potential flooding. Also, it may be an area that seasonally fills to create lakes and then dries up in the hot summer months. The units of measurement are not specific, so it's just to demonstrates how surface water levels can change over time by rainfall, drainage and evaporation.

Well Output (Groundwater Bore Output) will provide how productive the groundwater bore is over time. The measurements are not specific but an indication of how productive your groundwater bore pumps water. The different soil types where aquifers exist, how many groundwater bores in the area and accessing the same water source will affect individual groundwater bore output. This data will be indicated in the graph with colours matching the groundwater bores output.

Simulation 2. Confined vs Unconfined Aquifers'

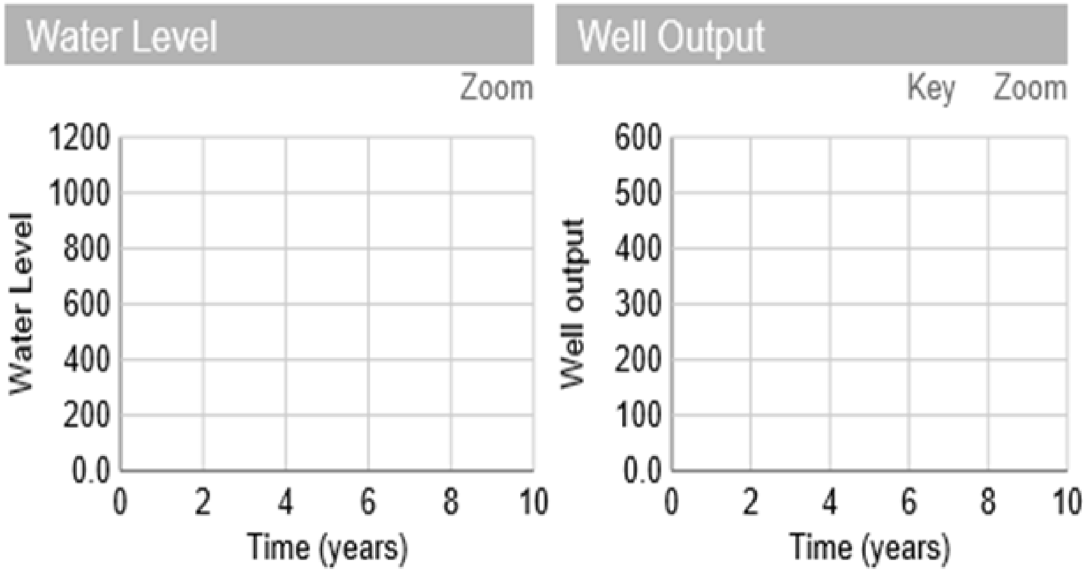


Table 3 Confined vs Unconfined Aquifer.

RUNNING DRY

Data Collection Graphs:

Water Level represents water on the surface. When there are large amounts of water on the surface it could indicate potential flooding. Also, it may be an area that seasonally fills to create lakes and then dries up in the hot summer months. The units of measurement are not specific, so it's just to demonstrates how surface water levels can change over time by rainfall, drainage and evaporation.

Well Output (Groundwater Bore Output) will provide how productive the groundwater bore is over time. The measurements are not specific but an indication of how productive your groundwater bore pumps water. The different soil types where aquifers exist, how many groundwater bores in the area and accessing the same water source will affect individual groundwater bore output. This data will be indicated in the graph with colours matching the groundwater bores output.

Simulation 3. Losing Stream

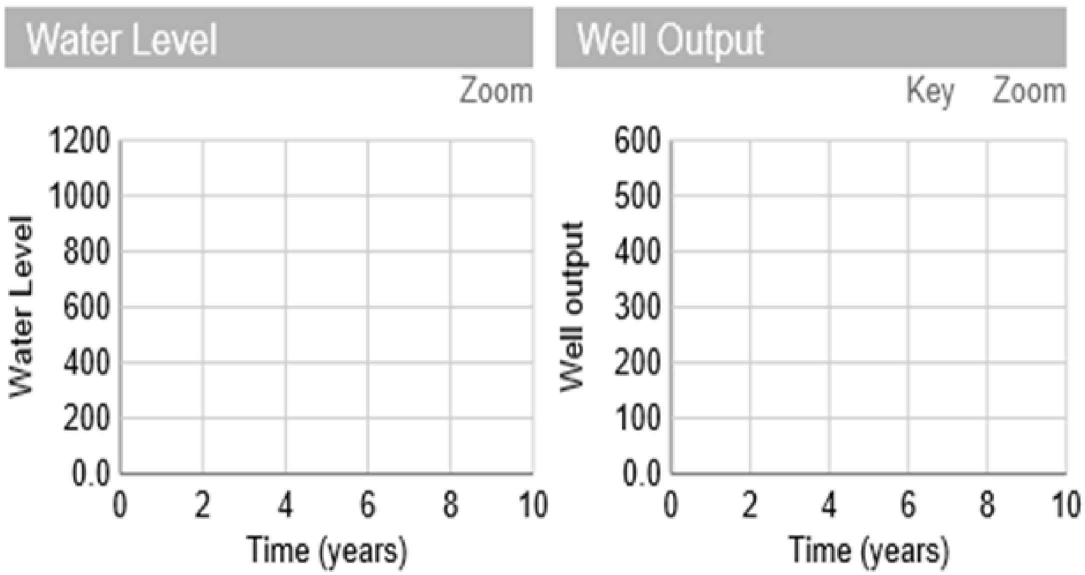


Table 4. Losing Stream

RUNNING DRY

Teacher Debrief Q&A Ideas

1. **The Central Coast has a mixture of rural and urban areas with a combination of soil textures and aquifer structures. Understanding this, why do you think groundwater bores are not found in more locations on the Central Coast to collect water?**
   Water may not be available in abundance in every location on the Central Coast for groundwater bores. The geology of the Central Coast plays a big part in where bore fields are located. Many of the borefields are located in sandy areas that allow water to make its way down into the aquifer. However, ground water also has an important environmental value and must only be used carefully

2. **Creeks and rivers are a major source of water for the Central Coast water supply system. How could extraction of water from aquifers affect creeks and rivers?**
   Water that enters the ground can travel through the soil to rivers and creeks; entering in through the banks and beds. Extracting too much water will not allow underground water to make its way to rivers and creeks. This could affect the aquatic life in creeks and rivers along with increasing the temperature of the water due to reducing the depth. Rivers and creeks that are deep will typically have a lower temperature which will also affect the oxygen levels of the water.

3. **In the simulations, the groundwater bores continually pump water regardless of use or availability of water. Discuss what are some possible impacts of unregulated pumping of aquifers.**
   Unregulated pumping of aquifers can have ecological impacts such as creeks and rivers drying up, the biodiversity of animal and plants decreasing, communities running out of water, displacement of people and businesses, water quality can change and the depth to access more water increases which also increases energy and costs.

4. **Why would having borefields spread out across the Central Coast be advantageous rather having them all in one location?**
   This allows aquifers not to be over-harvested in one location which then lessens the impact to streams and creeks in the area. Borefields spread throughout the Central Coast in areas where the geology is advantageous for water extraction lowers the costs of having to drill extra deep. If the borefields are relatively close they compete for the same water.

5. **Why are having borefields an important component for water security on the Central Coast?**
   Borefields provide a secondary measure during drought to access water. Using borefields for drought specific times enables accessibility of a water source in emergencies. It provides a water security insurance policy that supplements our main water supply sources such as the dams, creeks and rivers. Licensing is required to gain access to groundwater in NSW. The Central Coast Council needs to go through the NSW government Planning, Industry & Environment Department to create the borefields. Once the permits are granted the Central Coast Council can turn on the bores and start pumping water. The borefields are turned on periodically to sample the water quality and check if everything mechanically is working properly. The amount of water taken from the aquifer depends on environmental impacts along with the cost of pumping groundwater. Central Coast Council pays the NSW Government for the amount of water extracted from the borefields.


LOVE
WATER

BONUS

Mardi Dam and Water Treatment Plant School Tour

FOCUS AREA - Water in the World

Outcomes explored

A student:

- Explains how interactions and connections between people, places and environments result in change GE4-3
- Discusses management of places and environments for their sustainability GE4-5

Key inquiry question

- How do natural and human processes influence the distribution and availability of water as a resource?
- What effect does the uneven distribution of water resources have on people, places and environments?
- What approaches can be used to sustainably manage water resources and reduce water scarcity?

Content focus

Students:

- Investigate the nature of water scarcity and assess ways of overcoming it.
- Discuss variations in people's perceptions about the value of water and the need for sustainable water management

Content:

- Water Resources
- Australia's water resources
- Water scarcity and water management

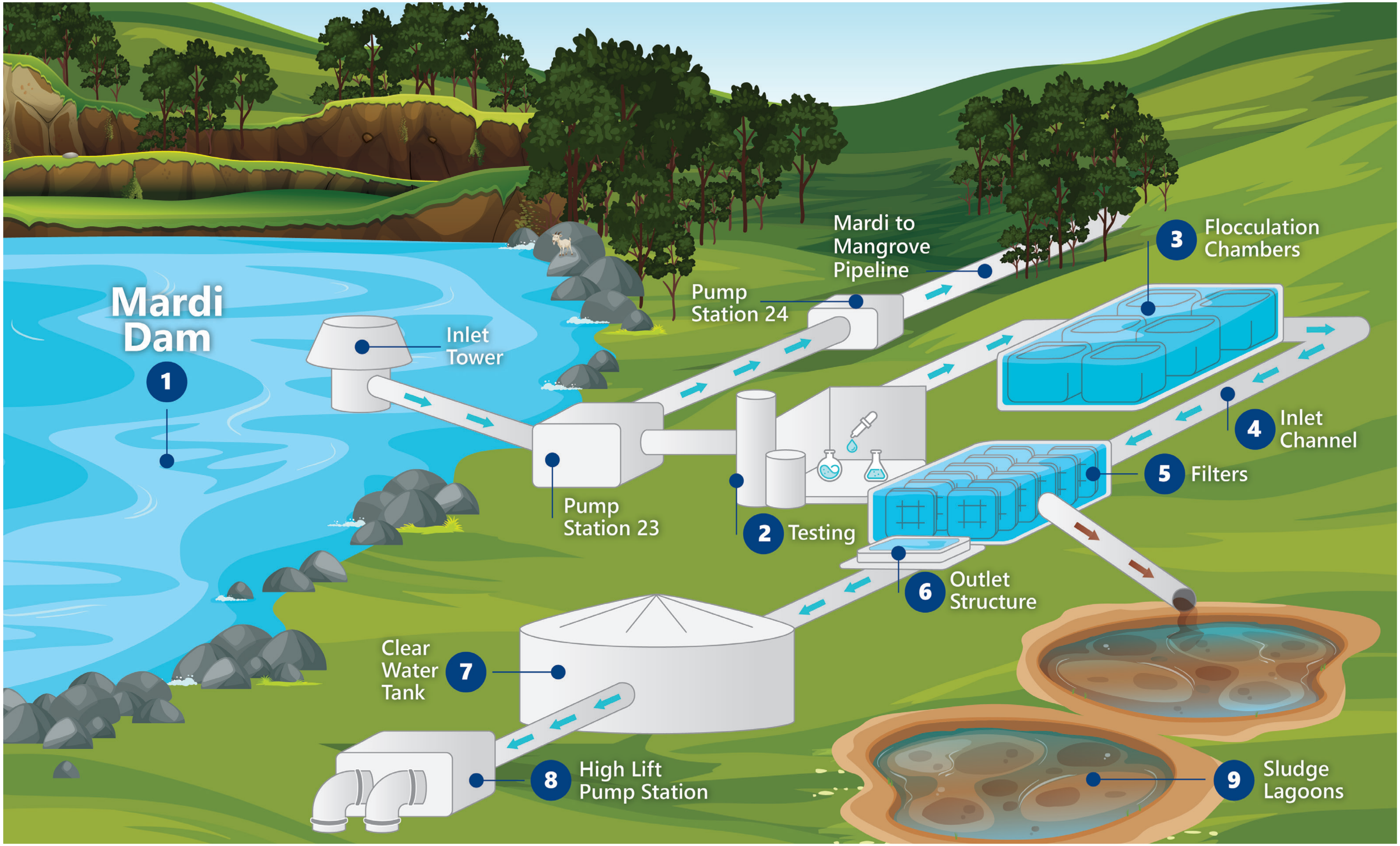
Excursion to Mardi Dam and Water Treatment Plant

Students have an opportunity to tour an important component of the Central Coast's water supply system. An expert from the Mardi facility will provide a behind the scenes look at the processes involved in treating water to make it potable and the significance of the facility for the Central Coast's water security. Students will explore the dam to learn where the water comes from and the dam's structural components. An illustration of the site with questions tied to the tour is available to complement this excursion.

Mardi Treatment Plant - Flocculation Chamber

Mardi Treatment Plant - Sludge Lagoons

MARDI DAM AND WATER TREATMENT PLANT



Excursion to Mardi Dam and Water Treatment Plant

Student Worksheet

Student Questions	Response
1. How deep is the dam at the lowest point?	
2. What is the total water holding capacity of the dam?	
3. How often do staff analyse the water quality?	
4. Flocculation chambers create floc which are small dirt particles attached to each other. What chemical do they add to make this happen?	
5. The inlet channel corrects the pH of the water passing through by adding which chemical?	
6. What materials are used to make the filters?	
7. Why is the outlet structure dark on the inside?	
8. The Clear Water Tank holds the treated water before it leaves the treatment facility. How much can the tank hold?	
9. High lift pumps are used to pump water to the Tuggerah Reservoir. How much water can the pumps move every second?	
10. In the sludge lagoons, the dirt eventually settles to the bottom and the clean supernatant (water on top) is removed. Where does it go?	

Excursion to Mardi Dam and Water Treatment Plant

Teacher Answers

Student Questions	Response
1. How deep is the dam at the lowest point?	**17 metres**
2. What is the total water holding capacity of the dam?	**7,400 million litres**
3. How often do staff analyse the water quality?	**Daily**
4. Flocculation chambers create floc which are small dirt particles attached to each other. What chemical do they add to make this happen?	**Liquid aluminium sulphate (Alum)**
5. The inlet channel corrects the pH of the water passing through by adding which chemical?	**Lime**
6. What materials are used to make the filters?	**Coal, sand and garnet**
7. Why is the outlet structure dark on the inside?	**Prevent algae growth**
8. The Clear Water Tank holds the treated water before it leaves the treatment facility. How much can the tank hold?	**15 Mega Litres or 15million litres**
9. High lift pumps are used to pump water to the Tuggerah Reservoir. How much water can the pumps move every second?	**1200L/Sec**
10. In the sludge lagoons, the dirt eventually settles to the bottom and the clean supernatant (water on top) is removed. Where does it go?	**Back to the dam**

Helpful Websites

Love Water Use it Wisely
https://lovewater.centralcoast.nsw.gov.au/

Central Coast Council Water Services
https://www.centralcoast.nsw.gov.au/residents/roads-and-water

Blueplanet
http://www.blueplanet.nsw.edu.au/home/.aspx

Drip Calculator
https://water.usgs.gov/edu/activity-drip.html

Reporting Local Issues
https://www.snapsendsolve.com/

Water Footprint network
https://waterfootprint.org/en/

Topographic maps
https://maps.six.nsw.gov.au/etopo.html

Central Coast Council

Love water, use it wisely
Stage 3 - Water Education Program

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