

# 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:

- 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

## 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<br>Shallow depth |       | Small Surface Area<br>Deep depth |       |
|---------------------|-------------------------------------|-------|----------------------------------|-------|
|                     | 1/12                                | 3/12  | 1/12                             | 3/12  |
| Date<br>(day/month) | 1/12                                | 3/12  | 1/12                             | 3/12  |
| Temperature<br>(°C) | 20°C                                | 28°C  | 20°C                             | 23°C  |
| Volume<br>(ml)      | 200ml                               | 110ml | 200ml                            | 170ml |

Table Shallow vs Deep Dam

### Student Results:

| Container           | Large Surface Area<br>Shallow depth |  | Small Surface Area<br>Deep depth |  |
|---------------------|-------------------------------------|--|----------------------------------|--|
|                     |                                     |  |                                  |  |
| Date<br>(day/month) |                                     |  |                                  |  |
| Temperature<br>(°C) |                                     |  |                                  |  |
| Volume<br>(mL)      |                                     |  |                                  |  |

### Conclusion

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# 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<sup>2</sup>
- 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<sup>2</sup> 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".

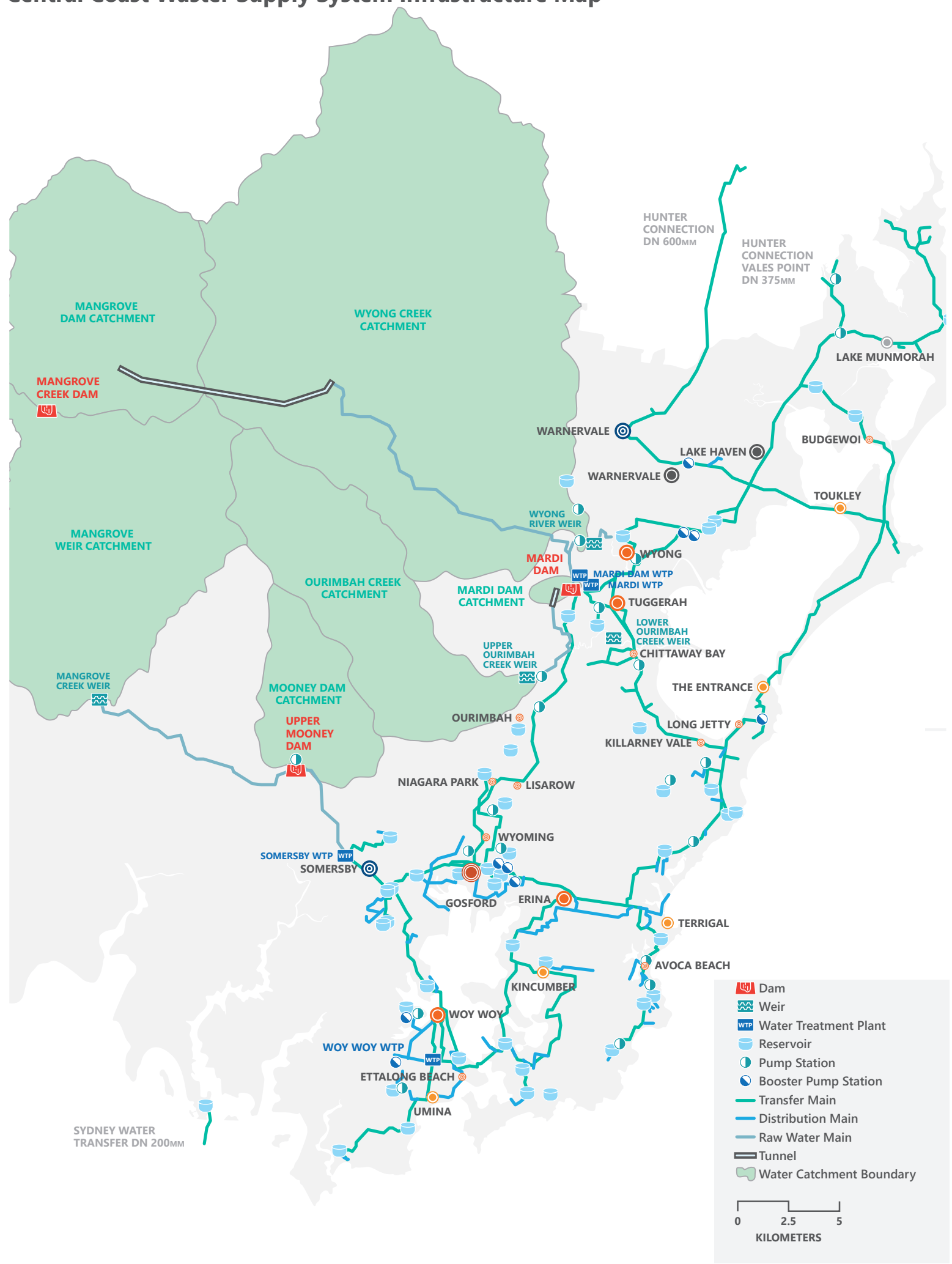
Students will be broken into four groups and provided an information card.

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



**Legend**

- Dam
- Weir
- Water Treatment Plant
- Reservoir
- Pump Station
- Booster Pump Station
- Transfer Main
- Distribution Main
- Raw Water Main
- Tunnel
- Water Catchment Boundary

**Scale:** 0 2.5 5 KILOMETERS

## 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 101km<sup>2</sup>
- Water can be sent to both Mardi & Somersby Water Treatment Plant.

*Mardi Dam* – 7,400 million litres

- Catchment area 2km<sup>2</sup>
- 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 39km<sup>2</sup>
- 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 355km<sup>2</sup>
- 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 140km<sup>2</sup>
- 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 88km<sup>2</sup>
- 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

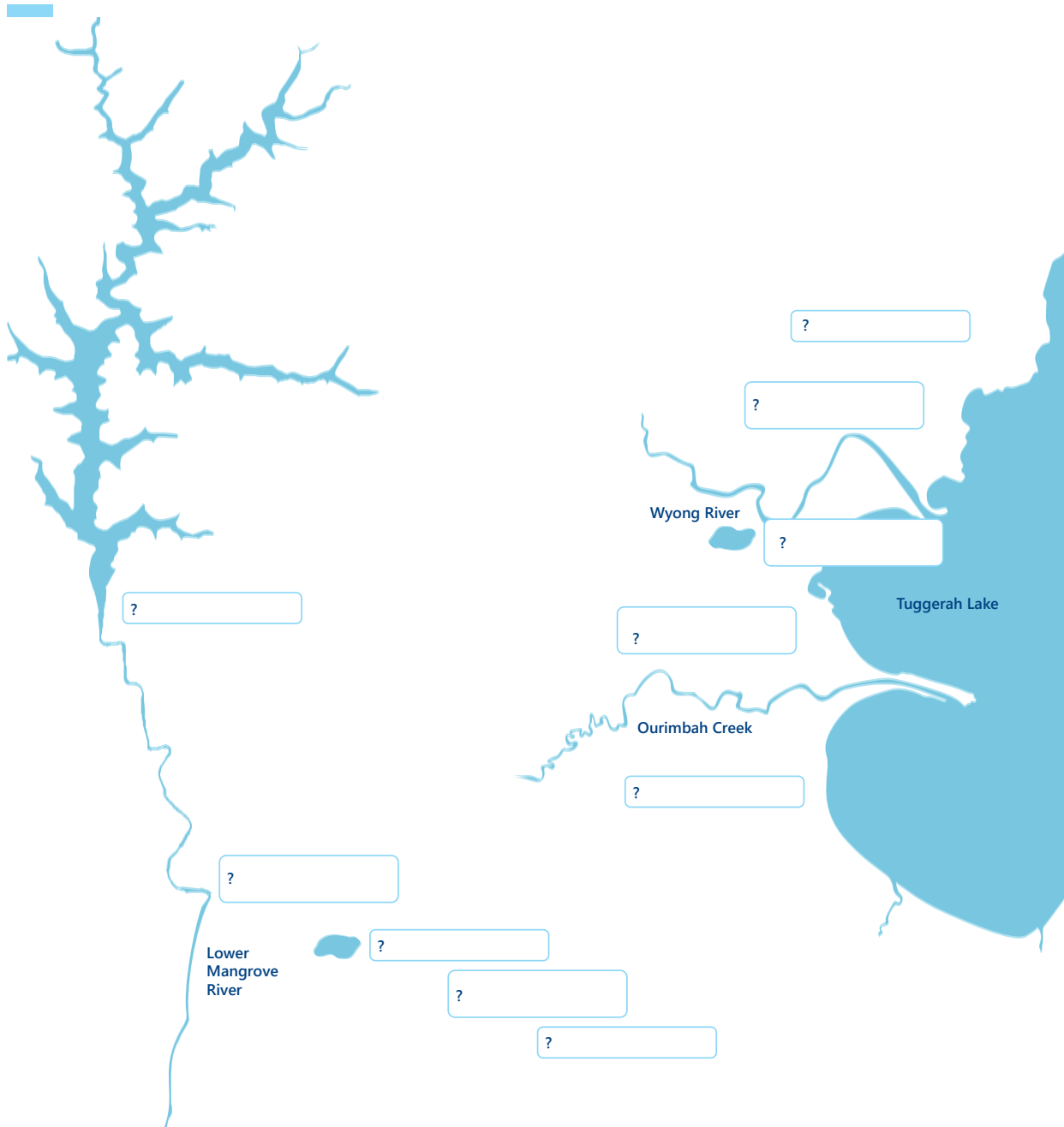
#### *Somersby Water Treatment Plant*

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

#### Items on Map

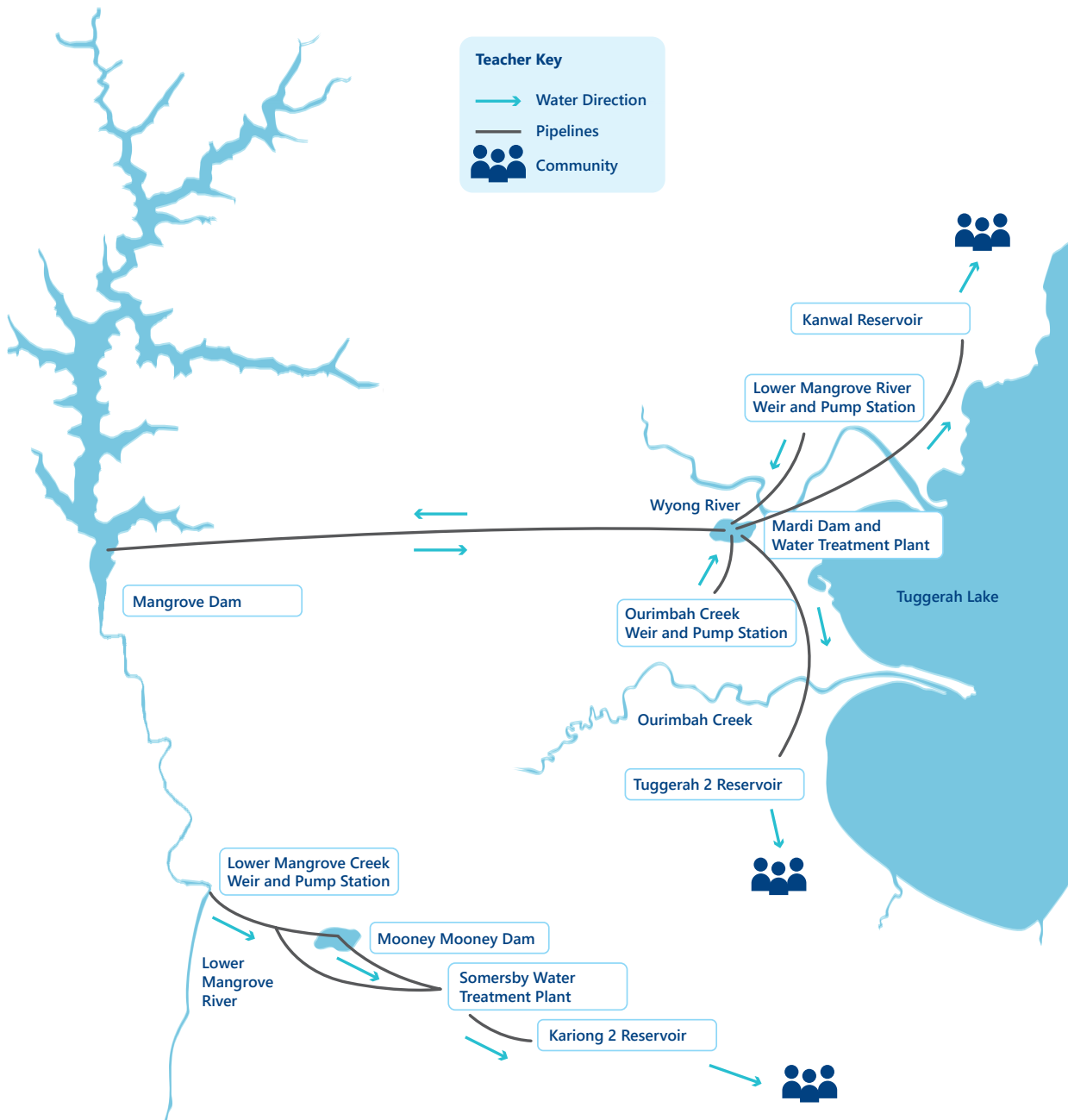
- Three soda caps (reservoirs)
- Black texter (labelling items)
- Two coffee filters (Water Treatment Plant)

# 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 Creek 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.