Module 3:
Water In Bathurst

Early Learning Water Education Program

Module overview

Learning Elements	Group Discussion	Activity
1. What is a dam and why are dams so important?	Have you ever been to visit a dam? Do you know what dams do and why they are so important?	Discovering dams, reservoirs, pump stations and filtration plants through photos and videos
2. The journey of water from dam to tap	How does water get from the dam to our taps? What happens to the water on its journey?	Journey of water from dam to tap! Water moving through pipes- an experiment that involves hypothesising and investigating
3. Why do water levels in the dam change?	What causes changes to the water levels in a dam?	Investigating and problem solving experiment to demonstrate changing water levels in a dam

Note: All URL's and links used throughout the Module are accurate and current at the time of publication.

Alignment with Early Years Learning Framework

Outcome 2: Children are connected with and contribute to their world.

- Children become socially responsible and show respect for the environment.

Outcome 4: Children are confident and involved learners.

- Children develop a range of skills and processes such as problem solving, inquiry, experimentation, hypothesising, researching and investigating.
- Children transfer and adapt what they have learned from one context to another.

Outcome 5: Children are effective communicators.

- Children interact verbally and non-verbally with others for a range of purposes.
- Children express ideas and make meaning using a range of media.

Telling the story of water

Meet the Wade family, they will help us tell the story of water.

Murphy Brooke Eddy Delta Murray Coral Douglas

Key terms

Term	Definition
Dam	A barrier constructed to hold back water and raise its level, forming a reservoir used to generate electricity or as a water supply.
Gigalitre (GL)	A unit of volumes equivalent to 1,000 megalitres, which is 1,000,000,000 litres.
Irrigation	Irrigation is the process of applying controlled amounts of water to plants at needed intervals. Irrigation helps to grow agricultural crops, maintain landscapes, and revegetate disturbed soils in dry areas and during periods of less than average rainfall.
Catchment	The action of collecting water, especially the collection of rainfall over a natural drainage area.
Water Filtration Plant	A water filtration plant is a facility that works to filter and purify water by removing chemicals, hazardous materials, and toxic matters from a water source. Most plants of this type filter drinking water suitable for human consumption.
Flocculation	Flocculation is a process by which a chemical coagulant added to the water acts to facilitate bonding between particles, creating larger aggregates which are easier to separate. The method is widely used in water treatment plants.
Pump station	Facilities including pumps and equipment for pumping fluids from one place to another.
Bore water	Bore water comes from groundwater which in turn comes from rain that has naturally seeped into the ground and is stored in spaces between soil and rocks. Groundwater is brought to the surface using a bore (well).
Capacity (dam)	The maximum amount that something can contain. When a dam is 'at capacity', it is full.
Evaporation	Evaporation is the process by which water changes from a liquid to a gas or vapour. Evaporation is the primary pathway that water moves from the liquid state back into the water cycle as atmospheric water vapour.
Drought	A prolonged period of abnormally low rainfall, leading to a shortage of water.

Background information

What is a dam?

Dams are built to control and store water. Dams are made from earth, stacked rock or concrete, and are usually constructed across rivers to store water in the reservoir that is formed behind the dam as a result of the river being blocked. Dams vary immensely in size and shape, from small farm dams that hold water for stock watering, to large dams which store water for large urban centres.

Australia is the driest inhabited continent and has the highest per capita surface water storage capacity of any country in the world. The large number and size of water storages is a function of both Australia's aridity and the highly variable rainfall. There are more than 820 dams on waterways in Australia with a total capacity of greater than 91,000 GL

The stored water in the reservoir behind the dam can be used for various consumptive consumption purposes, including use as water for irrigation, or as sources of drinking water for urban and regional towns and cities. The stored water can also be released from the reservoir during the times that natural flows in downstream rivers are inadequate to help meet a variety of environmental objectives.

Depending on the catchment area for the dam, the water stored in dam reservoirs is usually easier to treat to meet drinking water standards than other sources of drinking water, such as run of river supplies. This is because the quality of the water usually improves the longer it is stored in the reservoir.

Bathurst's dams

Chifley Dam

The major water storage for Bathurst is **Chifley Dam** located on the Campbell's River some 17 kilometres upstream of Bathurst. Water released from the dam flows down the Campbells River into the Macquarie River. It is then drawn from the Macquarie to supply Bathurst. Chifley Dam is an earth and rock fill structure. The catchment area is 960 square kilometres, and the dam's capacity, with the present wall height, is 30,800 million litres.

The earth wall is 455 metres long and 34.4 metres high. It has a concrete side channel spillway on the eastern side of the embankment. There is also a six bay, 172 metre wide emergency spillway excavated into natural material on the western side of the structure, designed to sequentially operate if the side channel spillway cannot cope with high flood flows.

Unless water level is low, Chifley Dam is open for all water activities, such as fishing and watersports – including skiing, sailing, powerboating, canoeing and swimming.

In August 2020, Chifley Dam was at 57% capacity, which was the highest level since January 2019. The table below allows comparison of water levels at Chifley Dam 2017-2020, at the same time of year.

Date	Water Level, Chifley Dam
August 2017	88%
August 2018	55%
August 2019	45%
August 2020	57%

Winburndale Dam

Windburndale Dam is located on the Winburndale Rivulet, some 21 kilometres east of Bathurst. Raw water from the dam is used primarily for park watering and industrial purposes. Water supplied to Bathurst from Windburndale Dam is provided in part by an old wood stave pipeline between the dam and the city.

The dam is a concrete gravity structure, 32 metres long and 22 metres above foundation level at its highest point. The abutments are earth fill, sealed with a thin layer of concrete. The capacity of the dam is estimated at 1,700 million litres, from a catchment area of approximately 88 square kilometres.

Bathurst's Water Filtration Plant - the process

Raw water contains undesirable sediments, colour, algae (which can produce a taste and smell) and other harmful organisms. The Water Filtration Plant (WFP) is designed to remove this undesirable matter, and produce water fit and safe for drinking, known as 'potable water'.

There are four x 11 metre long pumps installed on a platform beside the river lifting raw water up into the WFP. The WFP is designed to remove the undesirable matter, and produce water fit and safe for drinking. The raw water from the river system is delivered into a pit chamber or channel, where two chemicals are added and the mixture is agitated by a propeller-type 'Flash Mixer'. The chemicals used in raw water include:

- Alum (aluminium sulphate) to flocculate (join together) the tiny particles suspended in the water;
- Polymer, consisting of long chain molecules which join the 'floc' into even larger particles;
- Soda ash (sodium carbonate) to prevent the water from becoming acidic and therefore corrosive, as it would if only alum were added. This is used to adjust the pH at the end of the process.
- A powdered activated carbon (PAC) dosing plant is located near the raw water pumps (only dosed when there is an algae problem or taste or odour, which has been rare to-date).

PAC can be injected into the water to adsorb odours and toxic compounds produced by the algae. It is then removed by the conventional process. The mixture of water and chemicals is vigorously agitated a second time before being distributed by a channel into one of the three flocculation tanks. Here large horizontal paddles rotate slowly to encourage the floc to form and grow larger. From the flocculation tanks, the water enters the sedimentation tanks. As it flows slowly down these tanks, the large particles settle to the floor under gravity.

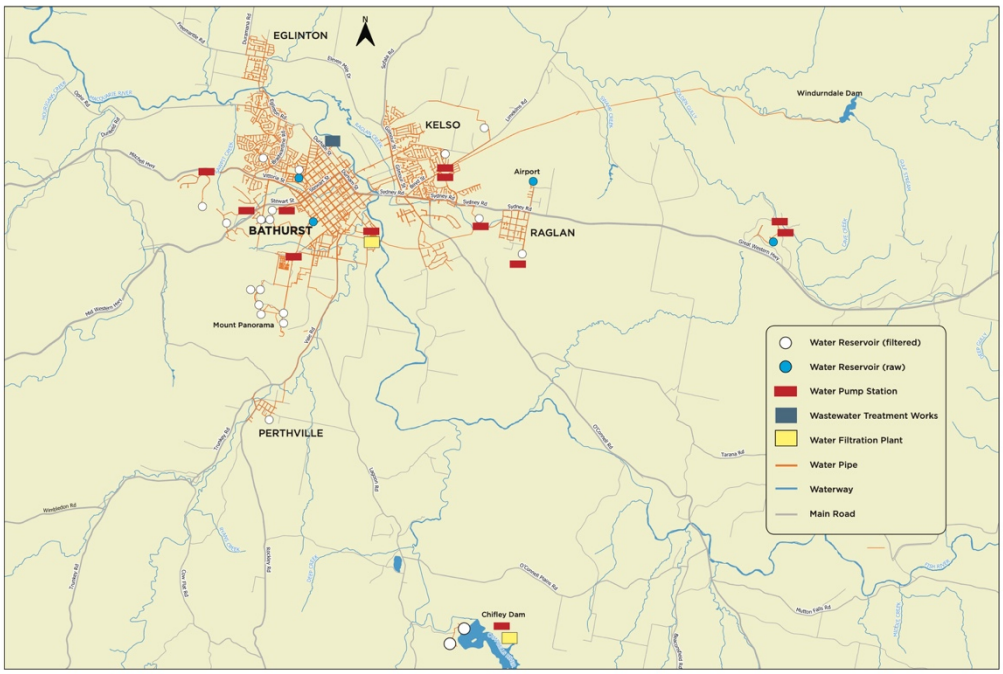
A sludge rake scrapes along the bottom of each of the three sedimentation tanks, collecting the settled sludge and pushing it towards hoppers at one end. From here it is released periodically to the sludge lagoons, which are drained so that the sludge can be dried and removed. After the heavier floc has settled, the water is passed through sand filters which collect smaller particles. The filters are periodically backwashed by forcing a combination of air and water up through the layers of sand, thus removing the fine material captured by the filters which could clog them. The filtered water drops into underground reinforced concrete clear water tanks, one of which is located under the main building. As it enters these storage tanks, it is treated with chlorine to kill any harmful organisms and with fluoride which aids in the dental health of the community.

From the underground tanks, the water is pumped into the town water supply system. Reservoirs located at high points in the system store the water and balance the usage against the capacity of the pumps. When the pumps are not running, the pressure in the system is maintained by feeding from the reservoirs. The plant has a complex control and monitoring system, allowing equipment to be operated either automatically or manually from a central control area. A telemetry system now complements the original electrical control system.

It exhibits on a computer screen the status of all the equipment in the plant, of the reservoirs and of the pumping stations. It also allows the plant to be controlled from a remote location, using a portable computer. Alarms are registered at the plant and are communicated to the operators by pager out of working hours, so that problems are dealt with promptly. A well-equipped laboratory enables constant testing of the raw water and of the treated water delivered to customers. It monitors such things as turbidity, colour and pH. Operators also do periodic testing for Coliforms or indicator bacteria, and algae identification and counting.

Council, in conjunction with the New South Wales Health Department, conducts a monitoring program to ensure the treated water complies with the Australian Drinking Water Guidelines 2011. The water tested for a comprehensive range of organic and inorganic analytics monthly and for indicator bacteria weekly. Any failures to meet the Australian Drinking Water Guideline's result in notification of the Local Health Unit and Council and investigation and remedial action are promptly instigated.

Support Resource:
Map of Bathurst Regional Council's Filtered & Raw Water System



AS AT NOVEMBER 2020

Support Materials, Links and Additional Resources

- Video: Bathurst Regional Council– Module 3: The Wade Family – Water In Bathurst
- Website: Bathurst Regional Council Catchments and water supply
- Book: Whizzy's New Adventures: Journey through the pipes
- Video: YouTube - The Wiggles- The Handwashing Song
- Website: Sydney Water resources for students and teachers

Learning Element 1:
What is a dam and why are dams so important?

I love to visit the Chifley Dam with my family. Sometimes we camp and other times we take the boat out on the dam when it is open. However, dams also play a very important role in providing water to drink.

Let's learn more about dams!

Group discussion:
Have you ever been to visit a dam? Do you know what dams do and why they are so important?

Resources for learning:

- *Web link to Chifley Dam water level information https://www.bathurst.nsw.gov.au/chifley-dam-details.html*

*Note: Refer to **Module 2: How do we use water? Learning Element 3 How do we use water at work?***

- Ask children if they know what a dam is. Ask if they have ever been to Chifley Dam in Bathurst- what did they do while they were there?
- Explain that dams are built to capture and store rainwater- almost like pouring water into a bowl or filling a bath. Ask the children to think about why we need dams. What do they think the water in the dams is used for?
- Ask if any of the children who live in rural areas have a dam on their property. What is the dam used for? Is their dam full or empty at the moment?
- Explain that, in Bathurst, the water from Chifley Dam supplies Bathurst with its drinking water. Explain that when the children fill up their water bottles or wash their hands, the water has come from the Chifley Dam. Clarify that if some children live on rural properties, then their drinking water may come from rainwater tanks if they are not connected to the town water system.

- Ask the children to think about what would happen to the water levels in the dam if it did not rain. Ask the children why this could be a problem. Tell the children how full Chifley Dam is at the current time and explain how the levels in the dam have changed over time dependent on the weather and the amount of rainfall.
- Introduce Bathurst's second dam, Winburndale Dam. Explain that this dam is primarily used to supply raw water for park watering and industrial purposes and not for drinking water.

Activity:
Finding out about dams, reservoirs, pump stations and filtration plants

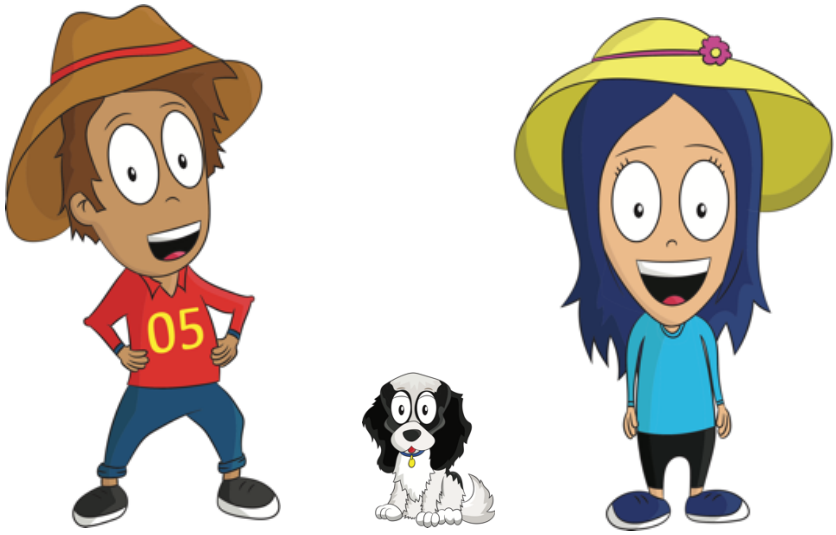
Resources for learning:

- *Support Resource: Chifley Dam*
- *Support Resource: Reservoir*
- *Support Resource: Water Pump Station*
- *Support Resource: Water Filtration Plant*

Note: Educators may choose to search for photos and videos on the internet, or visit Bathurst Regional Council's website to source more photos of local dams and water filtration centre

Visit: www.bathurst.nsw.gov.au

- Show the children the **Support Resources: Photos of Chifley Dam, a Reservoir, a Water Pump Station and Bathurst's Water Filtration Plant**
- Discuss the role of Council water operators and what they do.



Learning Element 2:
The journey of water from dam to tap

How many times a day do you turn on the tap? Maybe to wash your hands or fill up your water bottle. Have you every stopped to think about where the water comes from and how it gets to the tap?

Let's learn more about how water gets from the dams to our taps.

Group discussion:
How does water get from the dam to our taps? What happens to the water on its journey?

Resources for learning:

- *Video: Module 3:The Wade Family - Water In Bathurst*

Note: How and why water is cleaned before we drink it is covered in further detail in ***Module 5: Keeping our water clean and healthy, Learning Element 3 Why is it important to look after creeks and rivers?***

- Show the children the **Video Module 3 The Wade Family - Water in Bathurst**
- Explain to the children that the drinking water that comes out of taps in Bathurst comes from the Chifley Dam.
- Clarify that if some children live on rural properties, then their drinking water may come from rainwater tanks and that they might have their own dams or bore water on their properties to use on their paddocks and for their animals.
- Ask the children to describe what colour the water is that comes out of the tap in their learning environment - is it brown and dirty or clear?
- Discuss that the water has to be cleaned to make sure it is safe to drink. Talk about how the children would clean their hands or teeth to make them clean. Ask them how do they think you would clean water?
- Introduce the term 'water filtration' and give a simple description of how water is filtered and cleaned to remove all the dirt and sediments using the information provided in the background section.
- Explain how the water is then pumped from the water filtration plant into the town water supply system through an underground pipe system ready to be used in homes, schools and businesses across Bathurst.

Activity:
How does water get from the dam to our taps?

Resources for learning:

- *Support Resource: Map of Bathurst Regional Council's Filtered and Raw Water System*
- *Support Resource: Chifley Dam*
- *Support Resource: Reservoir*
- *Support Resource: Water Pump Station*
- *Support Resource: Water Filtration Plant*

- Show the children the **Support Resource: Map of Bathurst Regional Council's Filtered and Raw Water System** and ask them the following questions while they are looking at the picture. Children can come up and point to what they can see if the picture is displayed on a smart board or similar.
    - Who can see Chifley Dam? Who can see Bathurst? Point out the other suburbs marked on the map. Point out the airport.
    - Is Chifley Dam right next to Bathurst or further away?
    - Who can see the squiggly blue lines? These are rivers- how many can you see?
    - Point to the key showing the icon for a water filtration plant- who can see the water filtration plant on the map? Remind the children that this is where the dam water is cleaned
    - Point to the key showing the pump stations- how many pump station are there on the map? Count them together.
    - Point to the key showing the water reservoirs that hold filtered or cleaned water. How may filtered water reservoirs are there on the map? Count them together.
    - Point to the key showing the water pipes. Are there lots of water pipes on the map or just a few? What shapes do they make on the map?
    - Trace some of the orange lines (pipes) between the water filtration system and the pump stations. Explain that this is how the water moves from one area to another and eventually to our homes.
    - Explain that where all the orange lines (pipes) are located, is also where most people in Bathurst live and work.
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Activity:
Water moving through pipes experiment

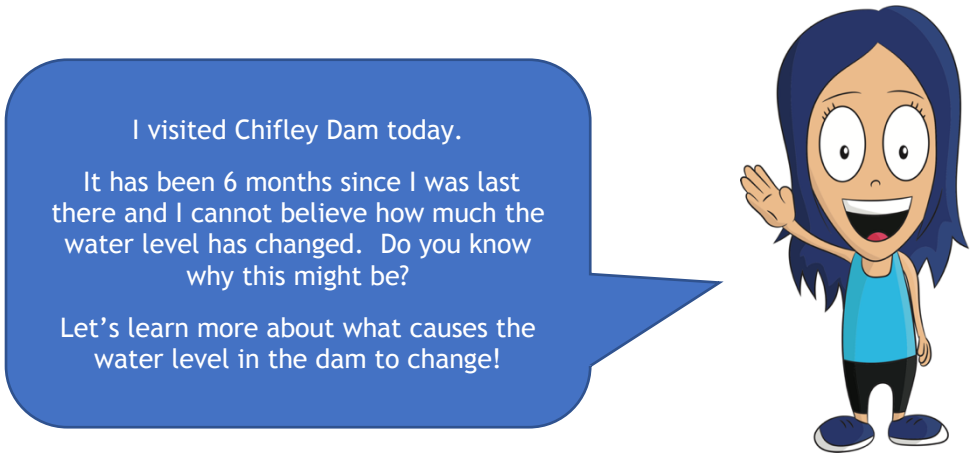
Resources for learning:

- *Plastic tubing of different lengths and diameters, watering can or jug (or similar), collection bucket, linking tubes (optional), water pistol (optional)*

Notes: This experiment is best done in an outdoor area. Children can take it in turns to pour the water into the pipes. Use a bucket to collect and reuse water to prevent wastage.

- Gather some transparent plastic tubing or pipes of different diameters and different lengths (e.g. from a local hardware store).
- Place the tubes at different gradients and different angles in an outdoor area.
- Pour water through each of the tubes/ pipes and time how quickly the water moves through.
- Ask the children to describe what they are seeing and how they would describe the movement of water in tubes of different diameters and different gradients.
- Use some linking tubes to connect the plastic pipes together into a network. Pour water in one end (the dam) and ask the children to describe the journey of water though the pipes and into the bucket (the home tap).
- For an extension exercise, use a water pistol to demonstrate how much faster water moves when it is under pressure. Explain that pressure helps water come out of the tap straight away when it is turned on.
- At the end of the experiment, reiterate that Bathurst's drinking water is fed into our homes via a series of underground pipes

Learning Element 3:
Why do water levels in the dam change?



Group discussion:
What causes changes to the water levels in a dam?

Resources for learning:

- *Activity Sheet: Complete the Water Cycle*
- *Activity Sheet: Wade Family Indoors*
- *Activity Sheet: Wade Family Outdoors*

Notes: Educators may also wish to revisit the Activity Sheet: Water Use Flash Cards, used in ***Module 2: How do we use Water Learning Element 2 How do we use water at home and in our learning environment?***

- Remind the children that a dam is a structure used to capture and store water that we use every day. Explain that the dam fills up when it rains.
- Revisit the **Activity Sheet: Complete the Water Cycle** from **Module 1: The Water Cycle - Learning Element 1 and 3** and explain that the sun can heat the water in the dam and cause it to evaporate. Explain this is similar to what happens to a puddle, but on a much bigger scale! When it rains, this can cause a puddle to form on the ground. Once it stops raining and the sun comes out, the puddle gradually dries up because the heat from the sun is evaporating the water.
- Using the **Activity Sheet : Wade Family Indoors** and **Activity Sheet: Wade Family Outdoors**, ask the children to identify the ways water is used by the Wade family
- Ask the children to think of all the ways they use water both at home and in their learning environment.
- Ask the children to think about what would happen to the water levels in the dam if everyone in Bathurst was using water every day for lots of different activities AND there was no rain. What do they think would happen to the water in the dam? Use the activity experiment below to demonstrate.

Activity: Experiment to demonstrate changing water levels in a dam

Resources for learning:

- *Large bowl, waterproof pen, small containers (e.g. yoghurt pots) – one for each child or can be shared, collection bucket, watering can*

Notes: Being conservative with water, water-saving pictures and how to be water smart are all covered in ***Module 4: Being Conservative with Water***

- Fill a large bowl (e.g. washing up bowl or similar) with water almost to the top.
- Use a waterproof pen or sticker to mark the water level at the start. Explain to the children that this bowl represents Chifley Dam.
- Give each of the children a small plastic canister (e.g. yoghurt pot, plastic cup or similar)
- Go around the table and ask each child to name one way they use water each day. Once they have said their water use, ask them to come up to the dam (bowl) and scoop out some water and then tip it into a bucket.
- Once all the children have had a turn, mark another line at where the water in the dam (bowl) has dropped to.
- Ask the children to describe what has happened to the water level in the bowl. Reiterate that this is what happens, on a much larger scale, to the Chifley Dam in Bathurst. When everyone uses water and it does not rain, the water level drops. Explain that this is why there are sometimes water restrictions (high, critical or extreme) in place in Bathurst to encourage everyone to try and save water so the dam does not run dry.
- Tip all the water from the bucket back into the bowl (dam) and repeat the experiment. This time, once a third of the class have removed their water for various water uses, use a watering can, to signify rain, to fill the bowl (dam) up.
- Ask more children to take water out, signifying further water uses and then use the watering can to again add more 'rain' to the dam.
- As you are going through this exercise, ask the children to describe what is happening to the water levels in the bowl and how they change i.e. when water is used, the water levels in the dam fall and when rain is added, the water levels in the dam rise.
- Explain that changes in water level also happens at the Chifley Dam based on how much rain the dam gets and how much water is used by the Bathurst community. During period of good rain, the dam fills up which means that water restrictions can be eased. However, in periods of drought (when there is no rain), people continue to use water but it is not getting replaced therefore water levels in the dam drop and water restrictions have to be introduced.