

DAMS OF GREATER SYDNEY AND SURROUNDS

Upper Nepean



Sydney's drinking water is collected from five catchment areas, occupying 16,000 square kilometres. Water is stored in 21 dams, holding over 2.5 million megalitres of water.

The dams of the Upper Nepean collect water from the catchments of the Cataract, Cordeaux, Avon and Nepean Rivers, which are tributaries of the Upper Hawkesbury–Nepean River. These systems supply water to the Macarthur and Illawarra regions, the Wollondilly Shire and metropolitan Sydney.

< AVON DRINKING WATER CATCHMENT

Introducing WaterNSW

WaterNSW is Australia's largest water supplier. We provide two-thirds of the water used in NSW and develop infrastructure solutions for water supply security and reliability.

We operate and maintain 42 large dams and we deliver water for agriculture and drinking water supply customers. WaterNSW also protects the health of Sydney's drinking water catchment to ensure highest quality drinking water is consistently available.

Sydney's drinking water catchments



The catchments

A catchment is an area where water is collected by the natural landscape. In a catchment, all rain and run-off water eventually flows to a creek, river, lake or ocean, or into the groundwater system.

Natural and human systems, such as rivers, bushland, farms, industry, homes, plants, animals and people can exist alongside one another in a catchment.

WaterNSW helps protect five catchment areas, which provide water to greater Sydney and local communities.

They are:

- Warragamba Catchment
- Upper Nepean Catchment
- Woronora Catchment
- Shoalhaven Catchment
- Blue Mountains Catchment

The catchments occupy about 16,000 square kilometres in total. They extend from north of Lithgow and Blackheath in the upper Blue Mountains, south to the source of the Shoalhaven River near Cooma, and from Woronora in the east to the source of the Wollondilly River near Crookwell.



^ UPPER NEPEAN CATCHMENT

Upper Nepean Catchment

The Upper Nepean catchment south of Sydney is in the zone of highest annual rainfall on the mid New South Wales coast. Its catchments include Cataract, Cordeaux, Avon and Nepean Rivers, which are tributaries of the Upper Hawkesbury–Nepean River.

The Upper Nepean system supplies water to the Macarthur and Illawarra regions and to the Wollondilly Shire. The system also supplies water to Sydney residents via Sydney Water's Prospect Filtration Plant.

The entire Upper Nepean catchment is declared a Special Area because of its significant conservation value. It contains extensive evidence of Aboriginal and European cultural heritage and also provides important habitat for native plants and animals.



Sydney's evolving water supply system



Australia is one of the driest inhabited continents on earth. Water has been vital to the survival and prosperity of Sydney since the first days of the new colony. The need to ensure a reliable water supply through times of drought and erratic seasonal rainfall has driven the development of several complex and innovative water supply schemes.

Sydney's first water supply came from the Tank Stream, named for the 'tanks' or reservoirs cut into its sides to save water. The stream, which wound its way through the colony before emptying into Sydney Harbour at Circular Quay, degenerated into an open sewer and was abandoned in 1826.

Convict labour then developed Busby's Bore, a four kilometre tunnel leading from the Lachlan Swamps, (now Centennial Park) and ending in the south-eastern corner of Hyde Park.

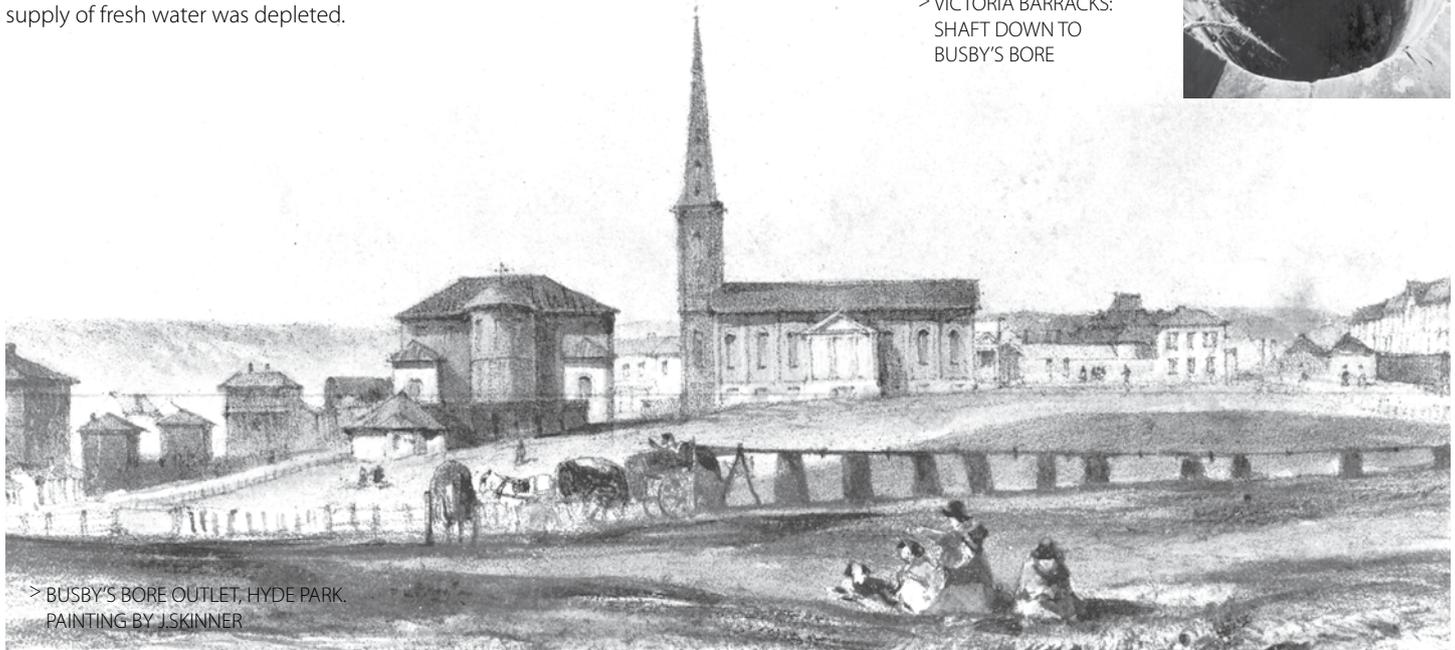
By 1852, drought and increasing population led to the call for a more permanent water supply for Sydney. A third water source, the Botany Swamps Scheme, began operations in late 1859 but within 20 years this once copious supply of fresh water was depleted.



^ TUNNEL INTERIOR
UNDER OXFORD STREET

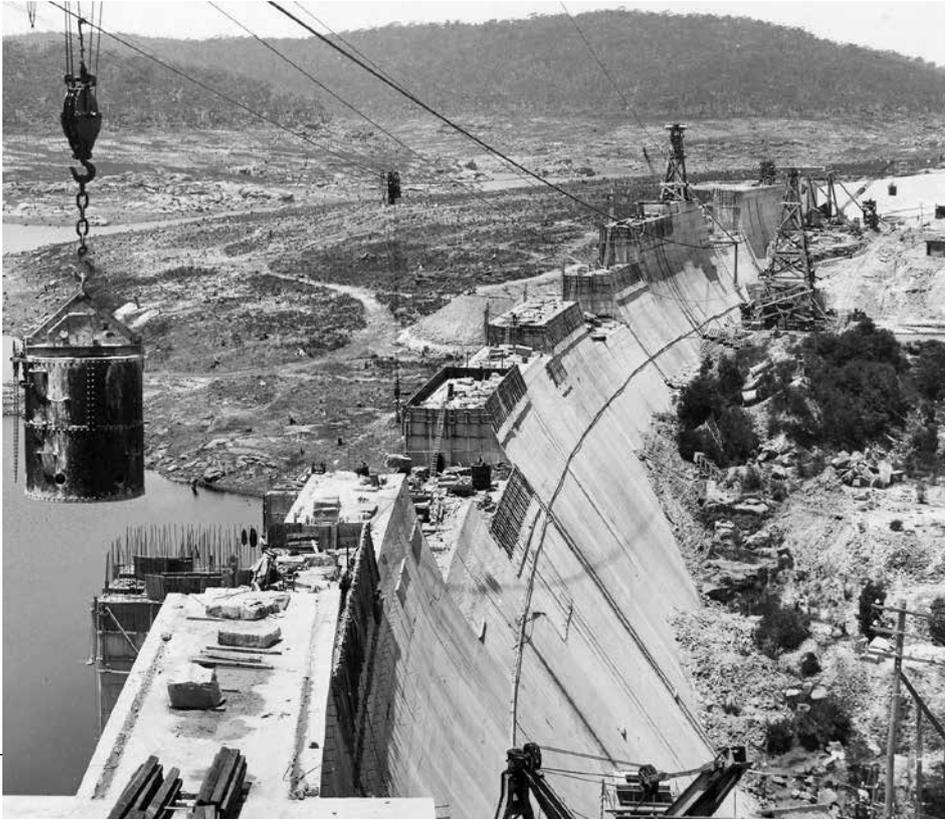


> VICTORIA BARRACKS:
SHAFT DOWN TO
BUSBY'S BORE



> BUSBY'S BORE OUTLET, HYDE PARK.
PAINTING BY J.SKINNER

Why the Upper Nepean Dams were built



The innovative Upper Nepean Scheme was Sydney's fourth source of water supply. Completed in 1888, the Scheme diverted water from a series of weirs on the Cataract, Cordeaux, Avon and Nepean Rivers to Prospect Reservoir via 64 kilometres of tunnels, canals and aqueducts collectively known as the Upper Canal. The Upper Canal System, which relies on gravity to divert water, was a remarkable feat of the time and still operates over 120 years later.

However the Upper Nepean Scheme provided only temporary relief to Sydney's water supply woes. The drought of 1901–1902 brought Sydney perilously close to a complete water famine. Restrictions were imposed on the use of water for anything other than domestic and trade purposes.

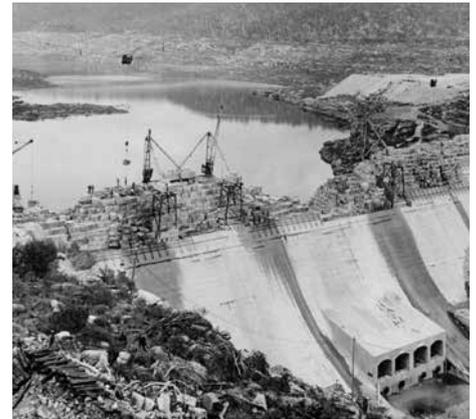
After two Royal Commissions into Sydney's water supply, the authorities agreed that a dam be built on Cataract River. The successive building of Cataract, Cordeaux, Avon and Nepean dams between 1907 and 1935 greatly improved the Upper Nepean Scheme's capacity.

Cataract Dam

Cataract Dam is located on the Cataract River, a tributary of the Nepean River, just below the junction with the Loddon River. By June 1903 much of the area to be submerged had already been cleared of timber.

For the first time in Australia, pre-cast moulded concrete blocks were used in construction for the upstream face of the dam. They were hauled to the site from an open factory on the banks of the Loddon River. Cement and other supplies were delivered to the site by steam tractors hauling trailer trains over rough roads from Campbelltown, about 28 kilometres away.

The dam was completed in 1907 and cost about \$1.3 million. When Cataract filled to capacity for the first time in January 1911, it soon became clear that the spillway should be widened to prevent any risk of floodwaters overtopping the dam wall. This work was completed in 1915. In 1968 a large flood saw the water level climb 1.5 metres overnight reaching 75 millimetres below the walkways across the wall. About 150 million litres of water was discharged out of the old spillway.



^ TOP: CHILD VIEWING CONSTRUCTION WITH MOULDED CONCRETE BLOCKS
ABOVE: UNDER CONSTRUCTION, OCTOBER 1906

Cataract Dam is a straight dam with an unlined side spillway extending from the left abutment. The weathering of the sandstone on Cataract, coupled with its stone battlements, has made it one of the most picturesque dams in Sydney. In 1987 Cataract Dam was strengthened by the installation of post-tensioned anchors at a cost of \$13.2 million.

Height: 56 metres
Length: 247 metres
Total capacity: 94,300 megalitres
Catchment: 130 square kilometres
Lake: 8.5 square kilometres



> CATARACT GORGE, THE SITE OF BROUGHTONS PASS WEIR

Did you know?



Avon, Cataract, Cordeaux and Nepean dams, and the Upper Canal System are listed on the State Heritage Register for their technical and aesthetic historic significance.



Famed Australian poet **Banjo Patterson** wrote a satirical ballad "The Dam that Keele Built" about the politics behind the construction of Cataract Dam.

Cordeaux Dam

Between 1907 and 1911 rainfall in the catchment was unusually low. Coupled with greatly increased water consumption, the need for additional storage was raised once again.

A site was selected for a reservoir on the Cordeaux River. Seasons of good rainfall followed for the next seven years, which delayed construction until 1918. In this same year a Board of Special Experts held another investigation into expanding the water supply system. The Board not only supported the proposed Cordeaux Dam, but also recommended building the Avon and Nepean dams.



During construction of Cordeaux Dam, cement and metal was transported to the site from the main southern railway 21 kilometres away via a five kilometre steam operated aerial ropeway built across the Nepean Gorge. The final journey was completed by a narrow gauge rail line.

The dam was completed in 1926 at a cost of about \$2.5 million. Cordeaux Dam is a curved dam with an unlined side spillway on the left abutment. Cordeaux was upgraded in 1988 at a cost of \$3 million with a system of drains in the wall and foundations.

Height:	57 metres
Length:	405 metres
Total capacity:	93,640 megalitres
Catchment:	91 square kilometres
Lake:	7.8 square kilometres

- > TOP: TURNING ON THE WATER SUPPLY
- > MEMORIAL GARDEN



Did you know?



The restored locomotive “**Kiama**” (now owned by the Illawarra Light Railway Museum Society) ran on a light railway between the Nepean Gorge near Douglas Park and the dam wall along Mount Keira Road during construction of Cordeaux Dam. It was later used to haul sand for the building of the Sydney Harbour Bridge.



The **Memorial Garden** in the picnic grounds and a plaque on the Valve House pays tribute to Guy Chalmers–Clift, 37, the Resident Engineer in charge of the dam’s construction.

On 10 March 1924, Clift and Constable James Flynn, 27, a local police officer, were shot while taking a suspect to Appin Police Station after a bungled attempt to steal the Cordeaux payroll. The intoxicated prisoner, William Simpson, 34, was later captured at the Royal Hotel, Appin, and was charged with the two murders. He was hanged at Long Bay Gaol in December 1924.

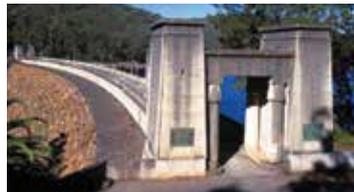
Avon Dam

Work on Avon Dam began in 1921. A curved dam with Egyptian style gateways at each end of the crest, Avon has a larger capacity than the Cataract and Cordeaux dams combined. The dam's spillway is a concrete serpentine weir with a concrete lined channel situated 400 metres from the left abutment.

All materials were hauled by truck on a road constructed from Bargo. For the first time electric powered cranes were also used in the construction.

Avon Dam was completed in 1927 and cost about \$6.3 million. It was strengthened in 1971 at a cost of \$3.8 million by buttressing its downstream face with a rockfill embankment.

Height:	72 metres
Length:	223 metres
Total capacity:	214,360 megalitres,
Catchment:	142 square kilometres
Lake:	10.5 square kilometres



^ TOP: AVON DAM SPILLWAY WITH SERPINETINE WEIR.

ABOVE: EGYPTIAN STYLE GATEWAY

Did you know?



World War I veterans staying at a nearby rehabilitation camp built the original roadway into the Avon Dam site in the early 1920s.



All construction materials for Avon Dam had to be transported in by road whereas the other dams in the Nepean system used rail transport.



^ BUILDING THE ORIGINAL ROADWAY, EARLY 1920's

Nepean Dam



Work on Nepean Dam started in 1925. It was interrupted for a few years by the Depression but resumed in 1933. Materials were hauled on a standard gauge railway line from the main southern line near Bargo.

The dam was finally completed in 1935 and cost about \$12.3 million.

After several years of extremely low rainfall in the catchment, heavy rainfall in October 1938 saw the dam finally reach capacity and overflow via its stand-alone crest level spillway.

A tunnel linking Avon and Nepean dams to enable transfer of water between the dams in either direction was completed in 1973.

Nepean Dam was strengthened in 1992 by post-tensioned anchors and a downstream rockfill embankment. It was further safeguarded by the addition of a concrete-lined side spillway on the right abutment in 1992.

Height:	82 metres
Length:	216 metres
Total capacity:	70,170 megalitres
Catchment:	320 square kilometres
Lake:	3.3 square kilometres

Constructing the Upper Nepean dams

All the Upper Nepean dams were constructed by the Public Works Department for the Metropolitan Water Sewerage and Drainage Board. They are all mass gravity dams, remaining in position under their own weight. They were the first dams in Australia of cyclopean masonry construction, an early masonry style using massive stone blocks. The sandstone blocks used weighed between 2 and 4.5 tonnes, and were quarried on site.

Following the construction of Cataract Dam, improvements in design and engineering led to several new features including inspection galleries, piping to register groundwater pressure, and upper and lower level discharge outlets for the later Upper Nepean dams.



^ MASSIVE SANDSTONE
BLOCKS USED IN DAM
WALL CONSTRUCTION

< NEPEAN DAM

SOCIAL LIFE THEN AND NOW AT THE DAMS

During the construction of the Upper Nepean dams temporary townships were established on each construction site. Married employees and their families rented the cottages while single men were accommodated in barracks.

With the completion of each dam, the township structures were moved on to the next work site or were sold for demolition or removal. The grounds were turned into garden parklands with picnic and recreational facilities.

Some families spent their whole lives at these dam sites, moving from project to project or staying on as dam employees.

PICTURE: CORDEAUX DAM OPENING LUNCH WITH ALDERMEN, 1927



How the Upper Nepean water supply system works

The Upper Nepean System supplies raw bulk water to four water filtration plants administered by Sydney Water, via 64 kilometres of tunnels, canals and aqueducts collectively known as the Upper Canal.

Water released from Cataract Dam flows down the Cataract River to Broughtons Pass Weir. Water released from Nepean Dam and Cordeaux Dam flows downstream to Pheasants Nest Weir on the Nepean River, where it is diverted via a seven kilometre long tunnel to Broughtons Pass Weir.

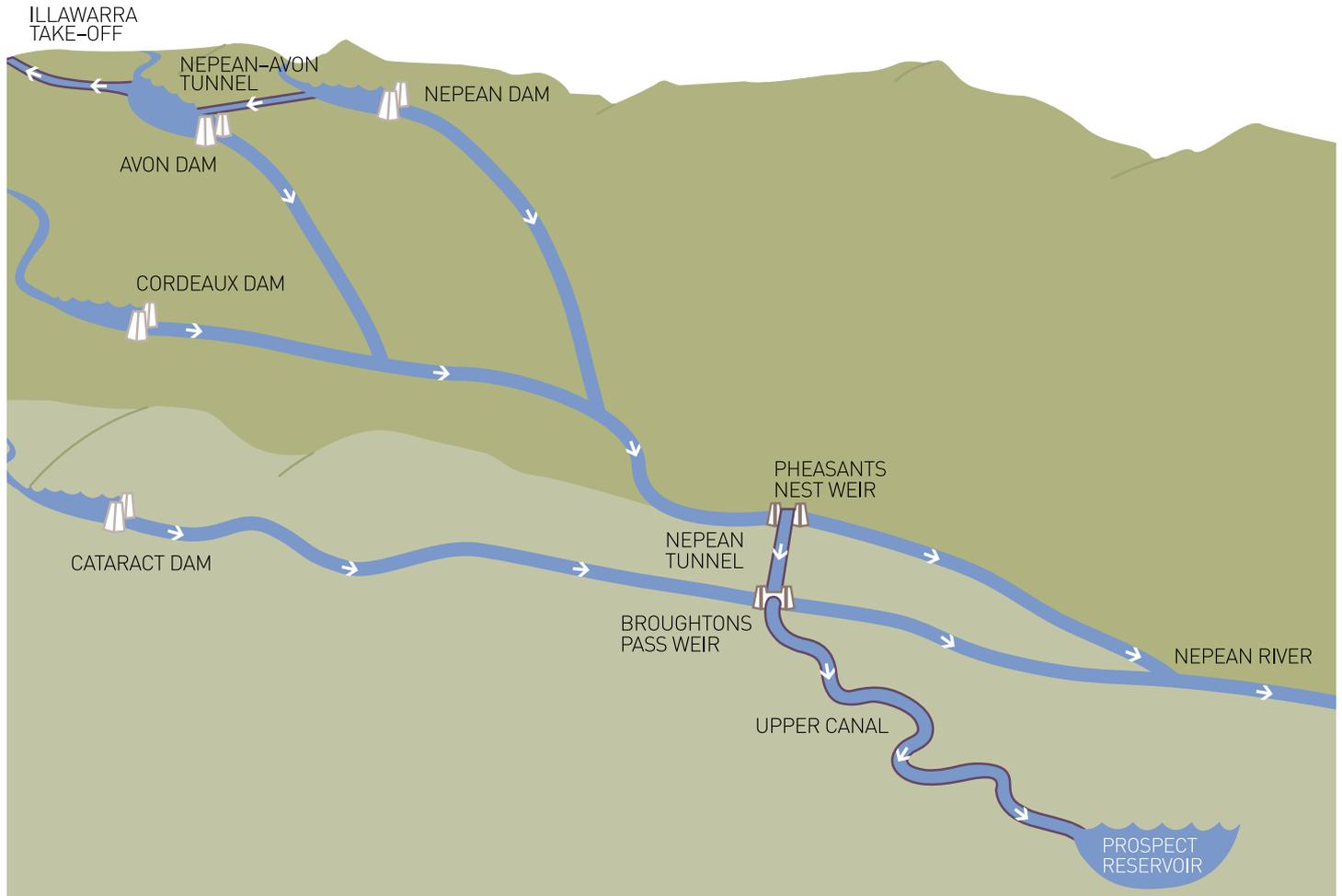
From Broughton's Pass Weir water is diverted into the Upper Canal where it flows 57 kilometres entirely by gravity to Prospect water filtration plant at Prospect Reservoir near Blacktown. Prospect water filtration plant receives raw water from both the Upper Nepean System and from Warragamba Dam and supplies filtered water to the metropolitan regions of Sydney.

Water is also pumped from Broughtons Pass Weir to the Macarthur water filtration plant near Appin, which serves Sydney's rapidly expanding south-west area around Campbelltown, Camden, Appin, Ingleburn and Wilton.

Water in Avon Dam is reserved for the Illawarra region and is gravity fed via pipeline to the Illawarra water filtration plant at Kembla Grange. Prior to filtering, the water is used to generate approximately 5.85 megawatts of hydro-electric power – which not only runs the plant but any excess is fed back into the power supply grid. Filtered water is supplied to the south coast area, from Scarborough to Gerringong.

Avon Dam can be supplied with additional water from Nepean Dam via a two kilometre long interconnecting tunnel. In times of drought Nepean Dam can receive water from the Shoalhaven Scheme via Wingecarribee Reservoir and the Glenquarry Cut.

Water from Nepean Dam is also pumped to Sydney Water's Nepean water filtration plant, which serves people living in the areas of Picton, Bargo, The Oaks and Oakdale.



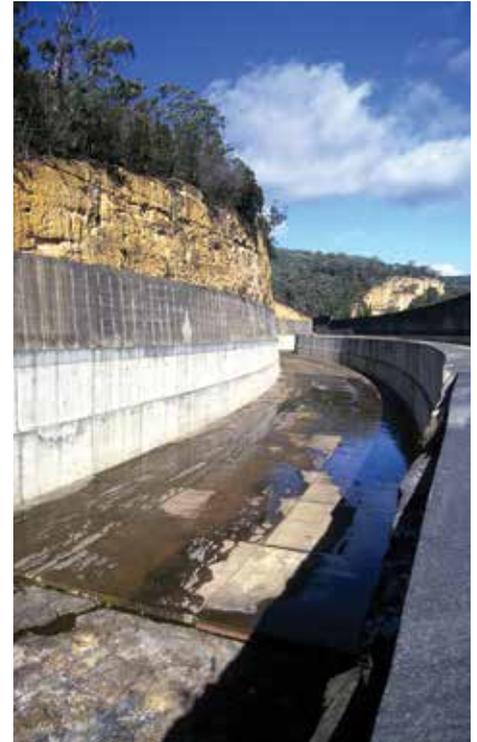
Ensuring dam safety

It is essential that all WaterNSW dams meet the requirements of the NSW Dams Safety Committee (DSC) under the *NSW Dams Safety Act (1978)*. The DSC, the State's regulator for dam safety, develops and implements policies and procedures for effective dam safety management in order to protect life, property and the environment from dam failures.

To ensure compliance with its operating licence, WaterNSW has adopted a structured program of surveillance and monitoring that complies with the requirements of the DSC and national and international best practice.



> NEPEAN DAM SPILLWAY



Monitoring water quality

In Greater Sydney's drinking water catchment, WaterNSW conducts extensive routine water quality and quantity monitoring in the catchments, storages and in-flows to water filtration plants. Monitoring provides information to enable the best quality water to be drawn-off into the supply system, and to identify areas requiring special catchment management attention. WaterNSW also conducts regular testing at several locations for the presence of the protozoan parasites *Giardia* and *Cryptosporidium* in the water. Information collected from WaterNSW's monitoring programs is used for public health reporting and assessment.



Maintaining good water quality in the catchment

WaterNSW works with government, industry and the community to promote good water quality and healthy, sustainable catchments.

Extensive research is carried out by WaterNSW to help understand the catchment environment. WaterNSW also plays an important role in ensuring that proposed land use and development is compatible with preserving water quality.

Field staff undertake a range of on-ground activities in the catchments, such as pest control, fire control, erosion control and repair, regulating access, containing spills and weed control. In the Special Areas (land closest to the storages) these activities are jointly managed by the National Parks and Wildlife Service (Office of Environment and Heritage) and WaterNSW.

Many successful projects are also undertaken jointly with landholders and community groups including riverbank stabilisation, willow removal, revegetation and riverbank fencing.

Environmental flows

WaterNSW recognises that its dams and weirs affect the natural flow of water downstream. WaterNSW provides water to downstream rivers through environmental flows - water released from the storages to help restore ecological processes and biodiversity of water dependent ecosystems.

Daily variable flows from the Upper Nepean dams and water supply weirs were introduced for environmental purposes from July 2010. Improvements to weirs along the Hawkesbury-Nepean River help the new flows make it downstream, with modified or replaced fishways to allow fish to move more freely up and down the river to breed.

At times of low flow, inflows to the Upper Nepean dams and water supply weirs are released to the downstream river. Daily variable inflows of up to 20.1 million litres are released from Nepean Dam, 6.8 million litres from Avon Dam, 4.5 million litres from Cordeaux Dam and 14.5 million litres from Cataract Dam. Inflows from the catchments between the Upper Nepean dams and weirs are also released from the weirs, including up to 4.4 million litres from Pheasants Nest Weir and up to 4.5 million litres from Broughtons Pass Weir.

> CATARACT DAM
ENVIRONMENTAL FLOWS



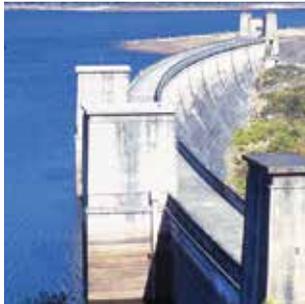
Did you know?



Torpedo nets were placed at Cataract and Cordeaux dams at the beginning of WWII to protect Sydney's water supply from being destroyed by enemy attack.



After Cataract Dam was built, the engineers realised that a curved dam wall was stronger than a straight wall in holding back a large volume of water. That is why all future dams in the Upper Nepean system were built this way.



< CURVED WALL
OF CORDEAUX DAM



In one of Sydney's **great engineering feats** of the 19th century, a seven kilometre long tunnel was built to connect the waters of the Avon, Cordeaux and Nepean rivers to Cataract River. The tunnel starts at Pheasants Nest, runs underneath the town of Wilton and empties into Cataract River at Broughtons Pass.



The discovery of **King Tutankhamen's Tomb** in 1923 led to worldwide fascination with all things Egyptian, and influenced the design of the gateways and valve houses of both Cordeaux and Avon dams. However, the Depression and the rise of Art Deco saw a more austere design for Nepean Dam.



< CORDEAUX DAM
GATEWAY

Recreation at the dams

All the dams in the Upper Nepean system are within easy driving distance from Sydney and offer an ideal location for picnicking, barbecues, walking and sightseeing.

Facilities are set in natural bushland surroundings with picnic shelters, shade trees, barbecues, drinking water, gardens, viewing areas and children's playgrounds.

Visiting hours are 10am to 5pm daily (7pm on weekends and public holidays during Daylight Saving Time). For more information on Upper Nepean dams visit www.waternsw.com.au.

For educational excursions and project material, please contact our Education Office on (02) 4774 4435

There are no entry fees to any of our dams. Picnic areas cannot be reserved.



Avon and Nepean Dam Facilities

Electric bbqs



Playground



Toilets



Drinking water



Viewing area



Picnic shelters





Cataract and Cordeaux Dam facilities

Electric bbqs



Playground



Toilets



Drinking water



Viewing area



Picnic shelters



How to get there



Cataract Dam is located about 84 kilometres drive south-west of Sydney, off the Appin-Bulli Road.

From Sydney, take the Hume Highway (F5) to the Campbelltown exit and follow the Appin Road south. At Appin, take the road towards Bulli-Wollongong, and then right to Cataract Dam where signposted.



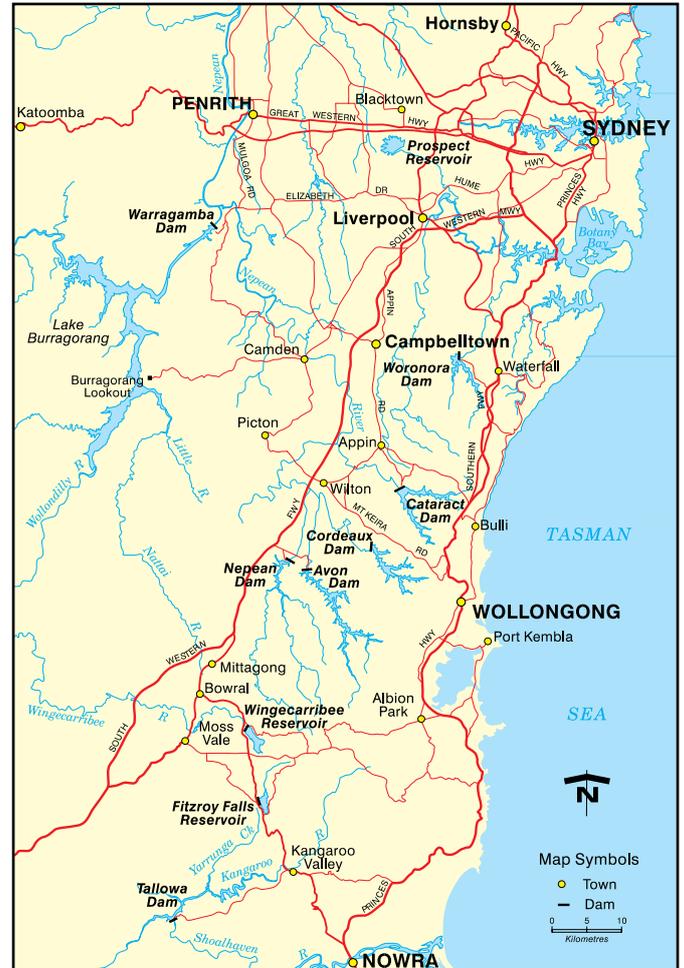
Cordeaux Dam is located about 94 kilometres drive from Sydney.

From Sydney, take the Hume Highway (F5) towards Canberra. Past Campbelltown, take the Wollongong/Picton turnoff. The Cordeaux Dam entrance is about ten minutes on the right, and is signposted.



Avon and Nepean dams are situated approximately 100 kilometres drive from Sydney.

Follow the Hume Highway (F5) south from Sydney, and take the Bargo exit to Avon and Nepean dams.



Why Special Areas are protected

About 890 square kilometres of the Upper Nepean catchment is classified as Special Area. In total, Special Areas cover about 3,700 square kilometres of land surrounding water storages.

The Special Areas protect our water supply because they act as a buffer zone, helping to stop nutrients and other substances that could affect the quality of water entering the storages.

WaterNSW and the National Parks and Wildlife Service (Office of Environment and Heritage) jointly manage the Special Areas, in accordance with the Special Areas Strategic Plan of Management.

This long-term plan aims to provide high quality water in the storages, ensure ecosystem integrity, and improve the environmental quality of the catchment areas.



> UPPER NEPEAN
SPECIAL AREA



Public access to parts of the Special Areas is restricted to protect water quality. This benefits the community by:

- ensuring we have safe, clean water
- protecting large areas of bushland and plant and animal habitats
- protecting threatened plants and animal species
- preserving evidence of Aboriginal occupation dating back many thousands of years, and
- preserving evidence of European exploration, early settlement, and phases of development such as forestry, mining and dam building.



Restrictions and controls are placed on land use, development and access within Special Areas. Activities such as swimming, fishing, boating and camping are prohibited, unless otherwise specified.

How you can help keep our catchments healthy



Saving water

Water is a precious resource. Each of us has a responsibility to reduce the amount of water we use – no matter where we live.

By reducing the amount of water we all use, we reduce the need to build expensive new water supply infrastructure such as dams, reservoirs and pipelines.

Reducing the amount of water we all use can also help make more water available for environmental flows, which protect the health of the rivers downstream of the dams.

WaterNSW recognises the need to adopt exemplary practices in managing our own business. Minimising leaks in pipelines and fitting water saving appliances and devices are just some of the ways WaterNSW is reducing the amount of water we use.

Water saving tips

For great water savings ideas visit www.waternsw.com.au/water-quality/education/learn/using-less-water.



In the catchments

People living and working in the catchment areas play a special role in keeping our catchments healthy. Some of the ways people in the catchments help include:

- using chemicals efficiently and carefully
- controlling weeds and pests
- retaining and planting vegetation to prevent soil loss
- protecting stream bank vegetation to provide a buffer against pollution
- managing on-site sewage systems effectively
- encouraging and developing improved sewage and stormwater management systems
- preventing bushfires
- reporting spills.



Contacting WaterNSW

169 Macquarie Street, Parramatta 2150
PO Box 398, Parramatta NSW 2124

Phone 1300 662 077
Office hours 8.30am to 5pm Monday to Friday
Website www.waternsw.com.au
Email customer.helpdesk@waternsw.com.au

Visitor information

Warragamba Dam Visitor Centre
Phone + 61 2 4774 4433
Hours 10am to 4pm daily
except Christmas Day and Good Friday

Other dams, reservoirs and camping grounds
Phone 1300 662 077
Hours 8.30am to 5pm Monday to Friday

Emergency reporting (24 hours)

Fires, chemical spills
Phone: 1800 061 069

Important

Information contained in this brochure may change after the date of printing. WaterNSW accepts no responsibility or liability for any loss or inconvenience incurred as a result of reliance upon information printed in this brochure. For the most up-to-date information on WaterNSW dams and recreational facilities, call 1300 662 077 or visit our website at www.waternsw.com.au

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