WATER TREATMENT
TREATING WATER WELL...

The water in Rocky Creek Dam comes from a healthy catchment. This means that, unlike some other water supply catchments, the water is not contaminated by agricultural run-off (eg, pesticides and fertilizers) or sewage from residences, and has a low risk of accidental spills from traffic (eg, petrol or other substances from trucks). It is important that we keep it that way!

The red soils and rainforest ecosystem, however, result in high levels of iron and organic matter in the water. When water levels are low in the dam, this situation is worse.

Water Quality Standards

For water to be healthy for us to drink, cook with and bathe in, it needs to meet certain standards. The Australian Drinking Water Guidelines define 'good quality drinking water' and recommend quantity limits of particular substances for human health and safety, and aesthetic quality. Rous County Council ensures that our water supply meets these standards.

Although normally beneficial for water quality, the storage of water in the dam, rather than its extraction from a flowing creek or river, can also reduce the water quality through 'eutrophication' and 'stratification'. When water levels are low in the dam, the potential for these situations is worse.

***'Eutrophication'** means "well fed" and refers to the amount of nutrients in water. When nutrients that feed plant life (particularly nitrogen and phosphorus) are in excess, they can increase undesirable plant growth such as algal blooms and aquatic weeds. Lack of water movement, increased water temperature, lack of shade and lack of biological interactions enhance the growth of algae. Management of the water body by Rous County Council aims to ensure the dam is functioning as closely as possible to a natural lake, with a good flow-through of water and healthy natural ecosystems, as this reduces the likelihood of eutrophication problems.*

***'Stratification'** refers to the splitting of water in the deeper parts of the dam into a warmer top level, and a cold bottom level. These layers do not easily mix. Over time, oxygen is unable to reach the bottom layer and bacterial and chemical activity become 'anaerobic'. Organic material can decompose into ammonia and hydrogen sulphide (rotten egg gas). Manganese, iron, phosphorus and sulphur are some of the elements that are dissolved in the bottom layer of water. These layers can suddenly mix due to season change, floodwaters or wind and wave action. This can mix these contaminants throughout the water. Stratification is prevented in the dam through the use of aerators which constantly mix the water so that the layers do not form (see Info Sheet 13: The Dam).*

For water to be healthy for us to drink... it needs to meet certain standards.

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According to these guidelines, unwanted substances in the water that need to be controlled include:

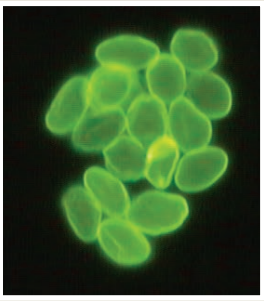
Colour, taste and odour

The guidelines state that water needs to be 'acceptable to most people'. This means that it needs to be 'clean and sparkling', and people generally find drinking water unacceptable well before the values of contaminating substances indicate a health threat.

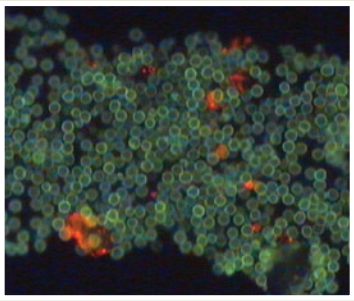
Manganese and iron

Minerals from the rocks and soil dissolve in the water supply. Iron levels are particularly high in the water at Rocky Creek Dam because of the volcanic nature of the geology (ie, 'red' soils). Neither element is a threat to health but they make the water look dirty and can stain bathroom and laundry fittings.

These 'contaminants' give us something to think about, because they mean that people may be able to have less heavily treated water if they are prepared to have less aesthetically pleasing (but still healthy!) water to drink.



Giardia cysts
© P. Monis



Cryptosporidium parvum oocysts
© P. Monis

Pathogens

These include bacteria and viruses, as well as single-celled parasites such as *Cryptosporidium* and *Giardia*. These micro-organisms are natural parts of healthy ecosystems and play important roles such as assisting in the decay of organic matter. Human disease can be caused by these organisms, including gastric disorders ranging from mild 24-hours 'bugs' to life-threatening diseases such as cholera. Many of these pathogens are removed with the removal of suspended solids. Disinfection either by chlorine, UV radiation, ozone or microfiltration, however, is essential to remove these organisms.

Suspended solids

These are most often clay particles or other natural material which can have microorganisms attached. Flocculation, sedimentation and filtration remove them from the water.

Blue Green Algae

Toxins, bad taste and odour can be produced by blooms of *cyanobacteria*, which can occur when levels of organic matter, nutrients, sunlight and water temperature are particularly high, and in still and slow moving water. There has never been a significant blue green algal bloom in Rocky Creek Dam, however, because it is such a healthy catchment. Existing treatment processes at Rocky Creek Dam cannot remove these toxins, and so protection of the catchment is the best way of protecting the quality of our water supply in this regard.

When water levels are high, the storage of water in Rocky Creek Dam can actually improve the water quality as micro-organisms die off and sediments with attached pollutants settle to the bottom. Even after a period of retention in the dam, however, the water quality is not adequate to meet the standards required.

Water is tested each week from different places in the water supply system, to ensure its quality.

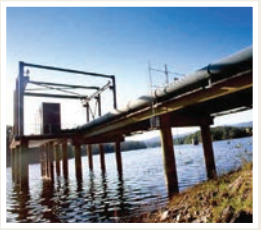
Water Treatment

The processes that are listed on the previous page are used to remove the 'problem' substances from the water. They are combined in the **dissolved air floatation** technology of Nightcap Water Treatment Plant.

The following series of processes is used to remove contaminating substances from water:

1. Raw water is **pumped** from the dam to the treatment plant.
2. Alum, lime and a poly-electrolyte (a type of long-chained chemical) are added to the water in the **flash-mixer**. Alum and the polyelectrolyte help suspended solids join together in clumps so that they can be easily removed from the water. Lime increases the pH (reduces the acidity) in the dosed water to assist this process.
3. This clumping together of suspended solids is called **'flocculation'** and happens in a tank where the water is mixed by huge stirrers.
4. Millions of micro-bubbles are then passed through the water from the **saturation** tank.
5. These micro-bubbles attach themselves to the 'clumped' solids and float them to the surface. The solids that float to the surface form a sludge, which is then skimmed off. The clean water underneath the sludge is then filtered by passing down through a bed of fine sand. This all happens in the **floatation and filtration tank**.

   Along with all the 'dirt', the alum used in flocculation is all removed during the flotation and filtration process. This **sludge** is subsequently treated in a sludge management and disposal process.
6. The filtered water then flows by gravity to the **filtered water tank**. Lime is added to the filtered water tank to increase alkalinity, which acts as a buffer against pipe corrosion and helps to stabilise pH.
7. Liquid chlorine (like pool chlorine) and ammonia is added for chloramination **disinfection**.
8. Carbon dioxide (CO_2) is added to **correct the pH** to drinkable standards (pH 7.5–8.5). The treated water then flows by gravity to a 13 megalitre storage reservoir called the clear water tank. From there it is released to the rest of the water supply system.
9. The sludge (from the flotation and filtration tank) is then thickened in a clarifier before passing into a centrifuge process. Water removed from the sludge during the thickening and centrifuge process is returned to the beginning of the treatment process. The 'dewatered' sludge is then taken away in a truck for reuse in a quarry rehabilitation project.

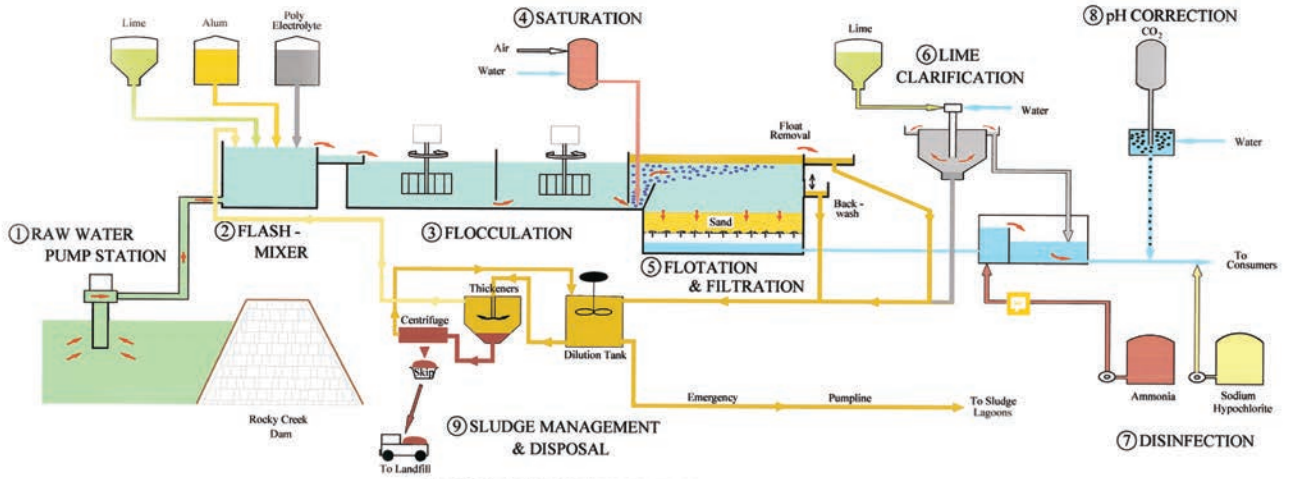


1. Pump from dam

2. Flash mixer

5. Floatation

6. Lime tanks



NIGHTCAP WATER TREATMENT PLANT
PROCESS SCHEMATIC

ROUS COUNTY COUNCIL

How 'clean and sparkling' do you expect your drinking water to be?

Water Testing

Water is tested each week from different places in the water supply system, to ensure its quality. Continuous in-line monitoring of water quality takes place at Nightcap WTP. This is backed by a comprehensive sampling and analysis program that addresses all of the requirements of the Australian Drinking Water Guidelines. All analyses are conducted by the Richmond Water Laboratories which is certified by the National Association of Testing Authorities (NATA).

The sampling and analysis program includes monitoring of the:

- quality of inflows from the water catchment area (including nutrients such as nitrates, phosphorus and nitrogen);
- water quality measures at various points in the treatment process (including manganese, iron, turbidity, colour and bacteriological quality);
- levels of dosing chemicals (including alum and lime); and
- levels of disinfection (including chlorine derivatives).

Target levels for all parameters are set well inside of the published guideline values, so that if the concentration or level of any of the 'unwanted substances' in the water starts to change, action can be taken to address the issue before the guideline value is reached.

Overall, the results of these tests can be used to change the treatment process accordingly, to ensure that all water supplied is in accordance with the Australian Drinking Water Guidelines, and to ensure the best water quality possible.

(Sources: 'We All Use Water' educational kit produced by Australian Water Association (2002); material about Nightcap Water Treatment Plant supplied by Rous County Council.)

TRY THIS!

Learn with your...

"If water testing showed that levels of bacteria in the reservoir at Byron Bay were higher than acceptable levels according the Drinking Water Guidelines, what do you think that the operators of the Nightcap Water Treatment Plant should do? What else do you think that Rous County Council could do? What could you do?"

"How 'clean and sparkling' do you expect your drinking water to be? If you had a chance to receive 'muddier' looking and tasting water that you knew was still healthy for you, would you drink it? How would you feel about that?"

"Carefully pick up a small handful of leaf litter from the forest beside you. Close your eyes and smell it. Imagine putting this handful of organic matter into your water bottle! The natural processes of filtration in the catchment, as well as the processes at the water filtration plant, need to filter all this material out before we eventually drink it. Think about it. Now carefully replace the leaf litter from where you found it."

Learning objective: *To understand the reasons for, and the process of, water treatment at Nightcap Water Treatment Plant.*

For further information contact:

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