

# WATER TREATMENT

## TREATING WATER WELL...

### Water Quality

The water in Emigrant Creek Dam comes from a catchment that is used for many purposes, including orchards and plantations, cattle grazing pastures, a fish farm, tourism, rural residential development and roads including the Pacific Highway (see *Info Sheet 15: Emigrant Creek Catchment*).

Potential sources of pollution include:

- septic tanks
- spraying/use of farm chemicals
- spills from highway traffic
- sediment and runoff from different land-uses
- algae and water weeds in dam
- cattle access to creeks and dam
- human access to dam



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 follow these guidelines.

Bugaw gala!



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.



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

### Colour, taste and odour

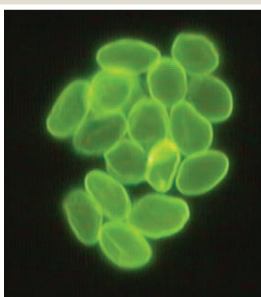
The guidelines state that water needs to be 'acceptable to most people'. This means that it needs to be 'clean and sparkling', and people generally find drinking water unacceptable well before the values of contaminating substances indicate a health threat.



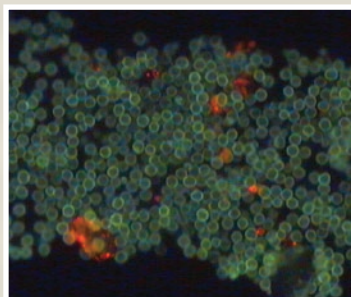
### Manganese and iron

Minerals from the rocks and soil dissolve in the water supply. Iron levels are particularly high in the water at Emigrant Creek Dam because of the volcanic nature of the geology (ie, 'red' basalt soils). Manganese levels are also high. Neither element is a threat to health but they make the water look dirty and can stain bathroom and laundry fittings. Chemical dosing makes these elements insoluble, and the particles settle out in sedimentation.

*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 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-hour 'bugs' to life-threatening diseases such as cholera. Many of these pathogens are removed with the removal of suspended solids. Disinfection either by 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 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 nutrient levels are particularly high. Ozonation and biologically activated carbon are appropriate treatments for these effects on water quality.

### Organic chemicals

Water coming from catchments where agricultural chemicals, such as herbicides and pesticides, are used may contain traces of organic chemicals. Road run-off can result in hydrocarbons entering the water supply. Advanced treatments using ozonation and biologically activated carbon are needed to remove these chemicals from the water.



## Rous County Council has planned and designed a new treatment plant for Emigrant Creek Dam... it uses the latest technology to deal with water quality hazards.

### Water Treatment

Water from Emigrant Creek Dam used to be pumped to Knockrow Water Treatment Plant (about 2kms east of the dam). Rous County Council identified the limitations of the plant in terms of its level of treatment and its capacity to treat the necessary volumes of water. For these reasons, Emigrant Creek Dam and the Knockrow plant were taken 'offline' in 1999 for over two years. At that time, all the water needed by Ballina and Lennox Head was supplied by Rocky Creek Dam.

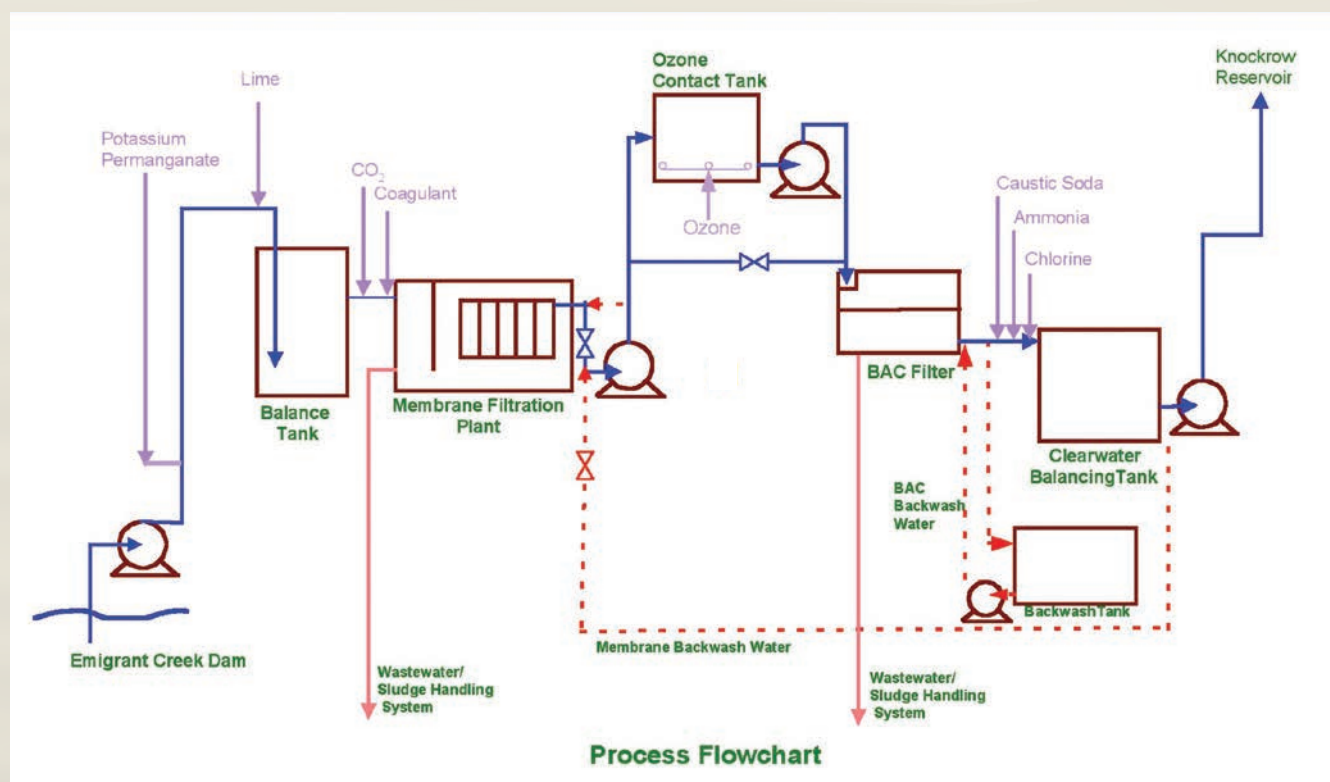
In 2001, Rous County Council completed a drinking water quality risk assessment for the Emigrant Creek water supply which identified the need for a comprehensive range of catchment management and water treatment requirements.

During the drought conditions of 2002, however, Rocky Creek Dam reached a record low and it was necessary to bring Emigrant Creek Dam and the Knockrow plant 'on-line' again.

Rous County Council planned and designed a new onsite treatment plant for Emigrant Creek Dam. This new treatment plant was constructed in 2005. It uses the latest technology to deal with the water quality hazards particular to Emigrant Creek Dam.

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

1. 'Raw' water is **pumped** from Emigrant Creek Dam to the water treatment plant.
2. **Chemical dosing.** At the pump station, potassium permanganate is added to the water to oxidise any dissolved manganese. Solid particles are formed through this process that can then be filtered out later in the process. Lime is then added to the water to raise the alkalinity. This prevents corrosion of copper pipes in the distribution system.
3. This 'dosed' raw water passes through the **balance tank** to allow for reaction time and for the water to stabilise before further





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



4. A chemical **coagulant** is then added to the water to form tiny sticky particles called "floc" which attract the dirt particles. These dirt particles are then removed in the membrane filtration process.
5. At the Membrane Filtration Plant, the water passes through microscopic **membrane filters** that remove solids and microscopic organisms including bacteria, Cryptosporidium and Giardia; improve colour and eliminate odor.
6. **Ozonation** takes place after membrane filtration in the ozone contact tank. The filtered water flows into a large concrete tank where ozone (O<sub>3</sub>) is pumped into the water and has contact with the water for at least 10 minutes. This provides further disinfection of the water.
7. **Biologically activated carbon (BAC) filters** are located after the ozone contact tank to remove algal toxins, taste and odour causing compounds and herbicides/pesticides from the water.
8. Caustic Soda and Chlorine are added to the water to further correct the water properties and kill any bacteria or micro-organisms that may be in the water. Water is then placed in the **clearwater balance tank** in order for disinfection to take place.
9. The water is then **pumped** to Knockrow Reservoir for storage and distribution to the community.
10. All the 'dirt' and chemicals removed during the filtration processes forms a **sludge** that is pumped into a wastewater collection tank, where it undergoes thickening and drying to make it suitable for disposal in Ballina Council's landfill. The excess water from the system is recycled back into the treatment process.

## TRY THIS!

### Learn with your...



"If water testing showed that levels of bacteria in the reservoir at Ballina were higher than acceptable levels according the Drinking Water Guidelines, what do you think that the operators of the Emigrant Creek Dam 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 it was still healthy for you, would you drink it? How would you feel about that?"



"Take a drink from your water bottle. Now imagine a 'cocktail' of agricultural chemicals, run-off from roads, even effluent from septic tanks being added to 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."

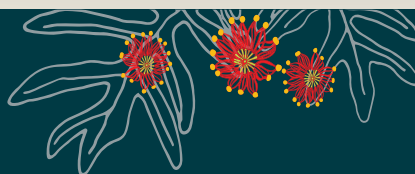
**Learning objective:** To understand the reasons for, and the process of, water treatment at Emigrant Creek Dam Water Treatment Plant.

(Sources: 'We All Use Water' educational kit produced by Australian Water Association (2002); Rous County Council Monitoring program: Emigrant Creek Water Monitoring Program (Nov 2002) by Sinclair Knight Merz; Emigrant Creek Dam Water Treatment Plant Options Study (2003) by Rous County Council & Dept of Commerce)



### For further information contact:

Rous County Council  
02 6623 3800 [www.rous.nsw.gov.au](http://www.rous.nsw.gov.au)



These information sheets were originally prepared for Rous County Council by Sustainable Futures Australia in liaison with Widiabul elders. © Rous County Council and Sustainable Futures Australia 2007. This is an educational project for the protection of water land, and for reconciliation.

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