# WWF'S WEDNESDAY WATER FILE

# DEBUNKING DESALINATION

**28 February 2018**

***Water, water everywhere – but not a drop to drink: Desalination can provide an important additional source of water for Cape Town as our existing freshwater sources become more stressed under conditions of drought and climate change. But removing salt from seawater is no silver bullet. Here's why.***

**1. So how does desalination work?**
Water is desalinated when it is treated to reduce the level of salts in it. Seawater typically has about 35 grams of salts (about 7 teaspoons) dissolved per litre of water. This is a concentration of 35 000 parts per million (ppm). The healthy limit for drinking water is 1 000 ppm and the upper limit is 5 000 ppm, so to make seawater fit to drink we have to remove at least 30 grams (6 teaspoons) of salt out of each litre of water. Separating the salt from the water takes energy. If seawater were to be left under a transparent dome with the energy of the sun shining through, about 3 litres would evaporate per day per square metre of water surface. If that water condensed again on the dome roof, you would have a solar still and you could separate small volumes of freshwater from seawater. To make large volumes of freshwater from salty water needs large quantities of energy. Depending on which method is used to desalinate (reverse osmosis/vapour compression/ membrane distillation) between 2 and 12kWh of electricity are needed per 1 000 litres.

**2. Where is desalination most common?**
The International Desalination Association estimates that there are nearly 20 000 desalination plants worldwide producing water for over 300 million people. The highest levels of use are seen in arid countries with few other options and relatively cheap and subsidised energy costs. Kuwait, for instance, gets all its drinking water from desalination.

**3. What about in South Africa?**
In South Africa desalination is used quite widely by mines to clean up polluted mine water and acid mine drainage. Small to medium-scale desalination has also been used in coastal towns during times of drought. Six municipalities are currently using small-scale reverse osmosis plants to desalinate water for bulk water supply.

- **Mossel Bay** has a medium size desalination plant capable of producing 15 million litres of potable water per day but the plant is currently on standby as the dams in the area are full. Standby mode requires continuous maintenance to keep the plant functional which costs the municipality money whilst not producing any water.
- The **Knysna municipality** has a desalination plant capable of producing 2 million litres per day which is currently shut down for maintenance and repairs. During normal operation, the plant is used at the discretion of the municipality. Currently there is sufficient water in Knysna so use of the plant is minimised due to the high operational costs.
- Plettenberg (**Bitou municipality**) has an operational desalination plant producing 2 million litres per day.
- There are two desalination plants in the **Ndlambe municipality**, namely the Bushman's River Mouth and Cannon Rocks plants, that produce 1.8 and 0.75 million litres per day respectively. Both plants are currently producing at full capacity.
- The **Cederberg municipality** has a plant in Lamberts Bay with a capacity of 1.7 million litres per day (upgradable to 5 million litres per day); however, this plant is not operational yet as it is still newly developed.
- **Richard's Bay** has a desalination plant that was installed during the 2016/17 drought to provide the town with 10 million litres per day. It has been operating at an average rate of 6 million litres per day. The plant has had several problems, particularly cable theft, which has interrupted supply, and excessive pressure, which resulted in pipe bursts in the areas receiving water.

**4. What desalination is in the pipeline for Cape Town?**
Four of the seven augmentation projects that will bring new water online for Cape Town are desalination plants. They are based at the Waterfront, Cape Town harbour, Monwabisi and Strandfontein (the latter two on the False Bay coast). These are relatively small-scale operations. The City has been criticised for initially trying to bring on smaller and quicker plants to provide water during a Day Zero scenario as these are more expensive. At one stage we were going to bring in desalination barges. Barges have only worked successfully in more sheltered sea areas in the Red Sea and the Gulf. There is very little international capacity in this market at the moment, and this is currently not a viable option for Cape Town. Barges are also generally more expensive than land-based desalination.

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**5. So why aren't we doing more desalination in Cape Town?**
For arid and drought-stricken coastal cities, desalination can be an important source of water which is completely independent of local rainfall. However, desalination remains the resource of last resort for most cities because it is the most expensive. Desalination takes longer to bring online than drilling the shallower boreholes in Atlantis and the Cape Flats. Desalination would also be more cost-effective at larger scales – between 150 to 200 million litres per day would be the best economy of scale for Cape Town.

**6. What other constraints are there?**
The availability of electricity is also a potential issue. Concerns have been raised in the United States that electricity supplies in local grids are not able to accommodate new desalination plants built in response to the Californian drought. South Africa is not long out of an electricity crisis. A further energy crisis at the same time as a water shortage would place this source at risk. Some plants overseas are starting to operate with solar energy, and this could be an option for Cape Town in the long-term. At the moment most of our energy is generated using coal-fired power stations and this means our energy generation puts a lot of greenhouse gases (GHGs) into the atmosphere which is a cause of climate change – which in turn would fuel future droughts.

**7. What is climate-neutral desalination?**
Climate-neutral desalination relies solely on renewable energy which doesn't produce GHGs and contribute to climate change. There are some examples of solar-powered desalination in California, however these costs are even higher than conventional desalination at this point.

**8. Are there any other environmental concerns?**
Desalination plants need to take in twice as much seawater as they produce freshwater. Often the intake points take in small organisms (fish larvae, plankton, etc) which can reduce local fish populations. A quantity of very concentrated brine is then produced, which generally will be disposed of back to the sea. As well as being very salty (which is toxic, even in a marine environment) this brine contains biocides and antifouling chemicals used in the desalination process which can also harm marine life.

**9. How expensive is desalination compared to other water sources?**
Globally desalination is between two to four times as expensive as most other sources depending on the relative cost of capital equipment (how much has to be imported etc), the cost of energy and the cost of labour to implement other water savings. By way of comparison the costs for Cape Town would be:

- **Raw surface water** | between R1 and R4 per kilolitre
- **Alien clearing to release more water from our catchments** | from R6 to R15 per kilolitre
- **New groundwater** | around R15 per kilolitre
- **Reclaiming and re-using treated waste water** | between R10 and R20 per kilolitre
- **Large-scale, permanent desalination** | between R10 and R22 per kilolitre
- **Smaller, short-term desalination** | R34 to R44 per kilolitre

**10. What are the long-term lessons here?**
Cape Town may need one larger scale desalination plant in the long-term. This would add a drought-proofed water source into our bulk supply. However, we have been warned about over-investing in a source that other (more wealthy countries) have had to mothball because of excessive energy costs. In Australia, the severe drought from the mid-1990s until 2012 prompted the construction of six large-scale seawater desalination plants at a cost of $10 billion Australian Dollars. The plants took years to build. Meanwhile, the National Water Initiative implemented water policy reforms and improved efficiency measures that led to cheaper water supply alternatives. By the time the plants were operational, the drought was over and the more cost-effective alternatives made desalinated water prohibitively expensive. Most of these facilities have stood idle, and operated at a significantly reduced capacity.

## DAY ZERO PREP - THIS WEEK'S BUCKET LIST:

- **Take regular readings of your water meter (preferably once a day) to keep track of water usage.**
- **Wash your clothes using the rinse cycle only and you can halve your washing water use.**
- **Be rigorous. Stick to the 50 litres of water per person a day to push out Day Zero as far as possible.**

**Useful links:**
International Desalination Association
Western Cape Government: Build the Water Sector
Key Issues for Desalination in California

*WWF South Africa compiled this Water File with the collaboration of researchers from the Centre for Renewable and Sustainable Energy Studies at Stellenbosch University.*