# WATER SUPPLY

# Are icebergs a realistic option for augmenting Cape Town's water supply?

With Cape Town staring down the barrel of the taps running dry, the question of the use of icebergs as an alternate freshwater source has once again begun to raise its head, around dinner tables, on street corners and in the press. But is this a viable water augmentation option? Article by Neil Malan.



Towing icebergs is not a new phenomenon, the idea crops up pretty much any time a major coastal city is beset by watersupply issues, as a series of feasibility studies by both US and Australian authorities (and most recently Abu Dhabi) in the second half of the twentieth century can attest.

That icebergs attract this kind of attention is perhaps not surprising, given the enormous size of the polar freshwater resource – a single large (in the order of 10 km long) berg contains enough water to supply Cape Town for a couple of decades. So, is it as simple as grabbing some free freshwater, or is this just the tip of ... er ... iceberg? One can go pretty deeply into this topic, but some frequently asked questions are summarised below:

#### Can we get it there?

*The short answer:* Maybe... Probably.

#### The long answer:

Icebergs are large, and heavy. Therefore, in order to get a decent-sized (say 20 km-long) iceberg it is estimated that some twenty large oceangoing tugs would be needed to move the



iceberg the 6 000 odd km from the Southern Ocean to Cape Town. This would be done at a speed of approximately one knot, thus making a journey of 250 days to reach the Cape and losing about 40% of its mass along the way.

With this class of tug being in limited supply, they cost around \$250 000-\$500 000 a day to charter. If one includes the need for each tug to be refuelled three times during the tow, you get to a cost of at least 2.5 Billion USD (to put this into perspective – this exercise would burn around 100 000 tons of fuel).

Despite being mathematically and theoretically possible, it has been these physical constraints which, in the some 200-year history of 'let's go get us an iceberg', has kept anyone from actually trying it. Although possible methods have evolved over the last 50 years and use of ocean currents or kites for propulsion, and shields to slow down the melting of the ice have been put forward, none of these are able to change the fundamental physical scale of the task. Small-scale experiments have proved that the instability of icebergs, due to their everchanging centre of gravity as they melt, makes the use of alternative propulsion methods very difficult.

It has also been proposed that the natural drift of the iceberg with ocean currents could be harnessed to direct it towards its destination. However, while this looks easy on schematic diagrams, in reality the ocean is a cauldron of turbulent currents (which we do not entirely understand at small scales) and in order to get to Cape Town, the iceberg would have to cross the Antarctic Circumpolar and Agulhas Currents, two of the most energetic ocean currents on the planet, as well as an area aptly known as the 'Cape Cauldron'.

As a marine engineering exercise this is a fascinating problem – how does one attach the tow cables, what do you do when the iceberg rolls over, how long will it take to get moving (several days actually), how does one steer it around other icebergs? Despite pitfalls, humans are creative when confronted with great challenges, and perhaps we do have the technological ability (given an unlimited budget) to transport an iceberg, but the bigger question remains, would we want to?

## How do we harvest it?

#### The short answer:

Not as easily as you might think...

#### The long answer:

Once an iceberg has arrived in Cape Town waters, it then has to be melted and transported to land. This would have to be done either by pipeline or tanker ship. The elephant in the room here is depth. An iceberg of the size needed for water supply will have a depth of at least 200 m. This depth requirement results in the iceberg having to be placed around 50 km offshore, and thus increases the cost and difficulty of transporting the water to shore. In addition to this is the challenge of keeping the water uncontaminated by salt and pollution during the melting process.

### What are the consequences?

#### The short answer:

How long is a piece of string?

### The long answer:

One can divide the consequences of iceberg harvesting into two main categories – the practical and the environmental (although some overlap between these is inevitable). Environmentally, the effect on local weather patterns and ocean currents would have to be quantified.

However, the presence of such a large, cold input of freshwater near the coast would undoubtedly have an effect on the coastal water circulation, which makes the ocean off Cape Town one of the most biologically productive in the world's oceans. This biological productivity is reliant on the upwelling of cold, nutrient-rich water from deep, which supports a staggering array of life, including most of the country's large commercial fisheries. A cap of cold, fresh meltwater could reduce the efficiency of this system, causing a regime shift to an alternative, and far less productive, ecological state.

Of more immediate impact and interest to most of Cape Town's citizens would be the effect of a large iceberg sitting offshore of the city on local weather patterns. One argument which could be made is that the cold air descending above the iceberg would result in a localised high pressure. The contrast of this with the warm land during the summer months could result in an acceleration of the South-Easter. An increase in these winds, even if only 10% or so, could have some fairly catastrophic consequences on the buildings of the city and has the added downside of deflecting rainfall from cold fronts southwards, away from the city and its catchment areas.

While there are many of this type of environmental consequences, which would have to be thoroughly explored through computer modelling simulations, there is a more immediate practical consideration to consider. Icebergs melt, and will do so at some speed in the mid-latitude climate of the Cape. In addition, they do not melt quietly and calmly. As they melt and are eroded by the wind and waves, their weight distribution changes, until such a point as they are off balance. What happens then is that the iceberg will turn over – which,

with the amount of weight involved, is not a trivial event. Think of the largest ship you can imagine capsizing, then add a few orders of magnitude.

These turnover events could also result in 'mini-tsunami' wave events which could prove a hazard to both shipping and coastal structures. However, the real danger here is that when an iceberg melts and turns over, it also splinters, resulting in the production of smaller icebergs and their pint-sized cousins, growlers and berg bits. These may sound cute, but each of them has the power to send a ship to the bottom. Hence, in mooring an iceberg off the coast of Cape Town, one of the world's busiest shipping lanes will become littered with floating hazards (most people have seen Titanic and can deduce what happens when ship collides with ice).

### Is it legal?

*The short answer:* No.

### Response to article – Iceberg harvesting IS a possibility

Dr Olav Orheim, initiator of the ship-bore iceberg observation programme under SCAR, Georges Mougin, Director of Water and Power from Iceberg, and Capt Nicholas Sloane, Director of the Resolve Marine Group disagree with Neil Malan's view. In a letter to SAEON they write: "we believe that the question of 'Ice to the Cape' is possible and shall become a reality if this concept receives serious evaluation."

They disagree with Malan's view of a 'decent-sized' iceberg. According to the letter writers, a realistic towable iceberg is  $1.0 \times 0.5$  km in above-water dimensions. "This size could provide Cape Town with 200 000 m<sup>3</sup> of freshwater daily, for about a year.

They also point to the particular nature of the large Antarctic icebergs as compared to Arctic icebergs. "These Antarctic icebergs are flat 'tabular' slabs of ice, and although many have internal flaws and therefore may break up, they do not roll over until their horizontal dimensions are reduced to about the same as the vertical dimension, which is generally around 250 m.

According to the authors, a 'small' tubular iceberg would not affect ocean circulation and local weather as it will be stranded many kilometres offshore. Thus its impact on local air and water temperatures would only be discernible immediately around the iceberg, with minor impacts on the local ecosystem.

"The article asserts wrongly that it will be illegal to tow icebergs from the Southern Ocean, and refers to the Antarctic Treaty. The Treaty does not discuss ice harvesting, which most likely is not covered by the Environmental Protocol under the Treaty. In any case, any towed iceberg would be picked up far north of 60°S, i.e. north of and

#### The long answer:

Under the Antarctic Treaty (the body which essentially governs how we treat Antarctica and its resources), activities related to the removal of mineral resources are not allowed. The loophole here is that icebergs are difficult to categorise (e.g. is it a solid mineral or a liquid water resource). However even if one wriggles through that loophole, the use of icebergs under the law of the sea would be subject to an environmental impact assessment.

Based on the key role which Antarctica and its ice play in driving the global overturning circulation, this would be difficult. Whilst water supply to populations in dry areas of the world can be seen as important, preserving the mechanisms which maintain our entire climate system (yes, the same system that allows human existence on earth at all) must surely be seen as a greater priority. It would therefore be difficult to see the decision to allow the harvesting of icebergs to be a moral one.

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outside the boundary of the Treaty. It would be an object floating in the High Seas, slowly melting on its eastward passage around the southern oceans, or awaiting to be harnessed by the first who could do so."

There are at any time around 200 000 icebergs floating in the Southern Ocean. While 20 km-long bergs are very rare, approximately 20 000 of the icebergs have lengths of over 0.5 km. Of course, a very small proportion of these will have the suitable position, size and strength for towing towards Cape Town.

The authors also caution the estimated cost of towing an iceberg to Cape Town. "The article states that the cost of towing a huge iceberg near to the Cape would run into billions of US Dollars. We estimate that towing, or guiding, realistic icebergs into the Benguela Current and making a landfall north of Cape Town offshore of St Helena Bay, would be less than the cost per cubic metre of desalinated water schemes presently approved by the Western Cape Government. We believe that with venture capital, the concept of 'Ice to the Cape' will become a reality in the near future, and certainly within the next five to ten years!"

