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Coastal dams are an alternative to desalination

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Southeast Queensland has seen the most rapid population growth in Australia, as the combined population in Brisbane, Gold Coast, Sunshine Coast and West Moreton increased by 27% between 1996 and 2006, accounting for almost a quarter of Australia's total population growth during this period. As its rainfall has been below average in recent years, the Queensland government has responded with a number of plans to supplement existing water supplies in the region. An article published in *Water Engineering Australia* (August 2010) claimed that desalination plants are seen as the main solution to future shortfalls. It stated that the Queensland Water Commission has assessed other alternatives such as dams, weirs and wastewater treatment as well, but they are not enough to meet the region's needs in the near future, especially when climate change may make the climate drier. Thus the commission concluded that future desalination plants at Marcoola and Lytton will be necessary.

It seems the commission only examined potential dams and weirs located in mountainous areas, such as Borumba Dam, Traveston Crossing Dam, Wivenhoe Dam and Mt Crosby Weir. Using conventional standards, southeast Queensland should be classified as an area of serious water stress, even if its rainfall (1149mm/a) is higher than other major cities, eg London (581mm/a), Paris (566mm/a), Moscow (522mm/a) and Beijing (630mm/a). Apart from high evaporation loss, the relative flat topography in this region is an important reason for the water stress as it limits the capacity of potential reservoirs. For example, the proposed Traveston Crossing Dam can only catch water from 22% of its catchment where the annual rainfall is around 1600mm/a to 2000mm/a.

Therefore, southeast Queensland is not short of water, but short of ways to capture and store it. Based on this fact, I would like to recommend the strategy of stormwater harvesting using coastal reservoirs. A coastal reservoir is a freshwater reservoir in the sea near a river mouth with sustainable river flow. The difference between inland reservoirs and coastal reservoirs is shown in Table 1. Theoretically, a coastal reservoir has the potential to capture and store every drop of water from its catchment, but in practice, due to the low water demand relative to the total runoff, only highest-quality water needs to be harvested.

To demonstrate the feasibility of the new strategy, I will take the Tweed River and Richmond River as an example. Their mouths are located approximately 90km and 160km south of Brisbane, respectively. The basic conditions of these two rivers are shown in Table 2.

A 2000GL coastal reservoir could be built near the mouth of the Richmond River at Ballina. The reservoir would be 30km long, 4.5km wide and its average water depth would be about 15m.

	Inland Reservoir	Coastal Reservoir
Location choice	Limited	Unlimited (inside/outside river mouth)
Dam design	High pressure	Low pressure but with wave/tidal surge
Seepage	By pressure difference	By density difference
Pollutant	Land-based	Land-based and seawater
Displaced population	High	No
Flooded land	Large	Zero

Table 1: A comparison between inland reservoirs and coastal reservoirs.

Current technology has no difficulty constructing such a dam. One example is the coastal reservoir of Shiwa Lake in South Korea, where the water depth is about 30m and the tidal height up to 10m. Another example is the Qingchaosha coastal reservoir in Shanghai, which cost about A$2.4billion for its 48km embankment and piping system, and will supply 70% of Shanghai's water demand.

As mentioned in Table 1, water pollution is one of the most challenging problems for the coastal reservoir. It could collect all contaminants from the catchment and improper design could lead to failure of coastal reservoir. For example, the Shiwa coastal reservoir has now been converted for tidal power generation. As the river water could be heavily polluted by domestic and industrial pollutants from Ballina, it is suggested to construct a by-pass canal to link the river and the coastal reservoir, approximately 20km upstream from the river mouth.

Although the capacity would be two thirds of the stream flow, ie 2000 GL, the water demand would be only 15% of the stream flow, and 85% of the river flow would drain to the sea. Thus the impact of coastal reservoir on the ecosystem would be negligible, especially when intake of river water occurs in flood periods.

The water cycle can be seen as a natural desalination plant, as seawater is evaporated by solar energy and its condensation yields rainfall. Artificial desalination in southeast Queensland may be unnecessary if we develop the existing freshwater resources.

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River	Catchment area (km^2)	Existing storage (GL)	Annual runoff (GL/a)	Estimated southeast Queensland water deficit in 2026 (GL/a)	Estimated southeast Queensland water deficit in 2051 (GL/a)
Tweed	1080	17	802	210	490
Richmond	6850	15	3345		
Total	7930	32	4147	5% of the runoff	11.8% of the runoff

Table 2: A comparison of Tweed and Richmond rivers and predicted shortfalls in southeast Queensland water supplies.