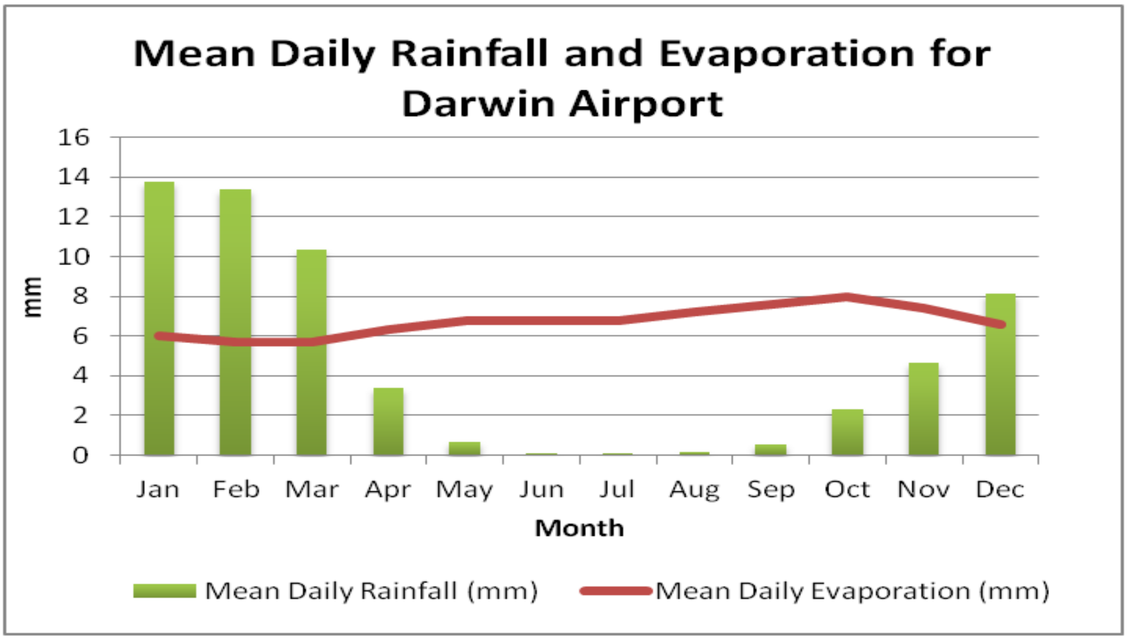
CLIMATE CHANGE ADAPTATION OF URBAN WATER MANAGEMENT SYSTEMS IN THE WET/DRY TROPICS

The objective of this thesis was to identify climate change adaptation strategies that have been implemented in the urban water resource management sector globally that could be incorporated into the Greenfield Weddell development located 40kms south of Darwin in the wet/dry tropics region of Australia. Particular attention was placed on assessing the functionality of Water Sensitive Urban Design (WSUD) as a climate change adaptation measure.

The Weddell Development

The Weddell development is located 40km south of Darwin and is expected to have up to 10,500 residents by 2021. This increasing population coupled with the projected climate change impacts predicted for the region will increase demand for potable water, reduce water security and exacerbate existing problems associated with the Darwin region's water supply and treatment system such as the large wastewater discharges during the wet season.

Average daily temperatures are consistently above 25 degrees. Daily evaporation varies between 5.5 and 8mm/day and is highest from September to October. Average daily evaporation exceeds average daily rainfall for the majority of the year in the Darwin region. This has implications on water demand patterns and results in water storages having to be large in size in order to accommodate the large evaporation losses characteristic of the area.



Climate Change and Urban Water Resources in the Darwin Region

Australia is considered to be one of the developed nations most vulnerable to climate change; whilst infrastructure in Australia is generally resilient to current daily and seasonal variability in climate, climate change is predicted to increase the frequency of climate extremes that exceed the typical variations in climate with which Australia's infrastructure can cope (Preston & Jones 2006; Garnaut 2008). Climate change impacts in the wet/dry tropics are expected to include an increase in extreme daily rainfall events, an increase in evaporation rates and an increase in mean temperature. Climate change will impact both water storage (supply) and usage (demand) in the wet/dry tropics.

Water use in Darwin is seasonally variable with wet season demands approximately 600L/capita/day rising to as high as 1400 L/capita/day in the dry season The average water use in Darwin city incorporating residential, government and commercial use is 960 L/capita/day. The wet/dry tropics region of Australia is characterised by a distinct seasonality in rainfall patterns that includes an extended dry period that occurs from April/May through to October. Mean annual rainfall is in excess of 1700mm/year. January is the wettest month having a mean monthly rainfall of 400mm. In contrast mean monthly rainfall does not exceed 10mm during June, July or August (BOM 2012).

The majority of residential potable water demand in Darwin is attributed to external use with 65% of residential water being used to water the garden (Power and Water 2006b). As there is a high quantity of potable water being used for the purpose of residential irrigation, actions such as increasing irrigation efficiency and the provision of 'fit for source' water for external residential use would provide efficient means of reducing potable water demand in the Darwin region.

MAJOR FINDINGS AND OUTCOMES:

Key Concerns

Key challenges to the implementation of WSUD in the wet/dry tropics include the characteristic extended dry period, the high mean annual rainfall and associated high flow scenarios, the likelihood of future extreme climate events and the issue of biting insects. Council members also expressed definite concern about the costs associated with the maintenance of WSUD elements including for example wetlands or bioretention pits and the potential liability this would represent responsible parties. There are fears over inadequate maintenance facilitating the creation of mosquito breeding sites or potentially rendering WSUD treatment trains redundant – i.e. if maintenance schedules were to lapse wetlands could become overgrown, or if sediment was not removed from bioretention pits their water treatment and peak flow attenuation effectiveness would be much reduced.

Inlet Zone at Fairway Waters in Durack Illustrating the High Sediment Loading of Incoming Waters

Outcomes and Recommendations

This study has found that WSUD elements could function as effective adaptation measures in the wet/dry tropics. Incorporating major decentralised stormwater storages into urban developments for example would decrease demand on potable supply and in so doing increase resilience to climate change in the region. However, there is a definite need for long-term studies that assess the practicality of various WSUD elements in the wet/dry tropics. Cultural norms including complacency to drought and high water usage are further issues that need to be addressed.

Water Sensitive Urban Design (WSUD) provides an effective method of improving discharge water quality, providing water storage capacity and achieving peak flow attenuation. This study has shown that successful designs from temperate and sub-tropical Australia are not directly transposable to the wet/dry tropics and that there is a need for location specific design features that include evaporation mitigation measures; inhibit mosquito and midge proliferation; and adapt WSUD elements to cope with the extended dry period characteristic of the wet/dry tropics. Practices such as irrigating WSUD elements in the dry season, correctly sizing and designing wetlands and the appropriate choice of vegetation will facilitate the implementation of WSUD in the wet/dry tropics. The maintenance of constructed wetlands is important given the potential for the proliferation of mosquito borne diseases including dengue fever.

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