INTEGRATED WATER MANAGEMENT PLANNING IN MELBOURNE, AUSTRALIA – MANAGING COMPETING OBJECTIVES

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INTRODUCTION

In Melbourne, Australia's second largest city, there are a large number of organisations involved in the provision of urban water services (i.e. reticulated water, sewerage and drainage). Yarra Valley Water (YVW) manages the reticulated water and sewerage systems. Melbourne Water (MW) is the catchment manager and is responsible for drainage services when the catchment exceeds 50ha, as well as wholesale water and sewerage services. Local Councils manage the drainage services for catchment areas under 50ha. Historically, these organisations have worked independently, focussing on their own responsibilities. To date this has been satisfactory, however faced with a growing population (from just over 4 million people currently to 5 million people by 2030) and an environment which is under considerable stress (due to reduced water storages as a result of drought, ever increasing greenhouse gas emission, and a Bay which is highly sensitive to the discharge of nutrients), a new approach is required to ensure the best holistic solution is identified.

This paper presents a decision making methodology which has been developed to measure the performance of a number of different servicing options against each of the key Integrated Water Cycle Management (IWCM) objectives. The methodology relates the overall performance of the option to its total community cost to derive a ratio which can be used to indicate community value.

In Melbourne, the Government has created an Urban Growth Boundary (UGB) which encompasses the city and defines where new developments can go, limiting urban sprawl. Within the UGB, there are three major development fronts, one of which is in Melbourne's North, covering an area of 9,500Ha. This area is earmarked for 90,000+ residential homes and 2,100Ha of employment land. Providing water, sewerage and drainage services to this area is estimated to have a direct total community cost of between $2.5-3.5B depending on the solution adopted. In consultation with all key stakeholders, the key IWCM objectives for the area were defined as follows:

1. Reducing potable water consumption.
2. Reducing the volume of treated effluent discharged to Port Phillip Bay and receiving waterways.
3. Improving stormwater quality.
4. Reducing stormwater runoff frequency and runoff volume.
5. Maximising the volume of stormwater/rainwater which infiltrates into the ground to generate baseflow.

With the world's population forecast to grow from 6 billion people to 9 billion people by 2050 and with most of these people living in cities, the challenge of providing services in the more sustainable and integrated way is certainly not unique and methodologies such as this will be useful in assisting the decision making process.

METHODOLOGY/ PROCESS

The options investigated (briefly defined in Table 1) were compared using the following methodology:

1. The sewerage, potable water, recycled water and stormwater systems were all hydraulically modelled to size the required infrastructure (at both the water company and customer scales) and quantify the environmental impacts, by calculating nitrogen, phosphorous, greenhouse gas emissions.
2. A multi-criteria assessment (MCA) model was developed, built around a set of sub-measures designed to measure the achievement of the IWCM objectives.
3. For each option, raw sub-measures scores were calculated. Scores were assigned (out of 100) based on the following framework:
   - 0 = poor performance - significant step backwards from current practice.
   - 50 = current best practice - adheres to current best practice guidelines (documented standards which could be enforced today).
   - 100 = world's best practice – eliminate or minimise impacts to pre-settlement conditions.
4. Each of the sub-measures were assigned a weighting using the Analytical Hierarchy Process pairwise comparison model.
5. Raw sub-measure scores and sub-measure weightings were combined to calculate a "weighted sub-measure score". For each option, these weighted sub-measure scores were then added together to get an overall option score.
6. For each option, the Total Community Net Present Cost was divided by the overall option score to obtain a "community value" ratio. Preferred options were those with the lowest NPC per unit of overall weighted score.

Table 1 Description of the types of options investigated

Potable Water	Recycled Water	Sewerage	Stormwater Quality
Reticulated supply only	No reticulated recycled water supply	Reticulated sewerage service Transfer all flows to the centralised system	Treatment measures must meet current best practice standards at the development boundary (80/45/45 - % removal of SS, TN and TP)
Reticulated supply with recycled water used to supply hot water systems	Reticulated recycled water supply for toilet flushing, clothes washing and outdoor uses	Reticulated sewerage services Local treatment and recycling (with only excess flows discharged to the centralised system)	Development and catchment scale flood protection assets
Reticulated supply with rainwater tanks at the allotment scale used to supply for toilet flushing, clothes washing, hot water systems and outdoor uses			Infiltration systems to manage overflow from rainwater tanks at the allotment scale

RESULTS/ OUTCOMES

Raw scores for each sub-measure were calculated and displayed graphically (Figure 1). This enables the performance of an option to be quickly analysed to see where it is falling short of current best practice standards. In the example below, the red line indicates current best practice (or a score of 50/100). Any bars which exceed the red line indicate achievement of current best practice standards whereas any bars below the line represent a failure.

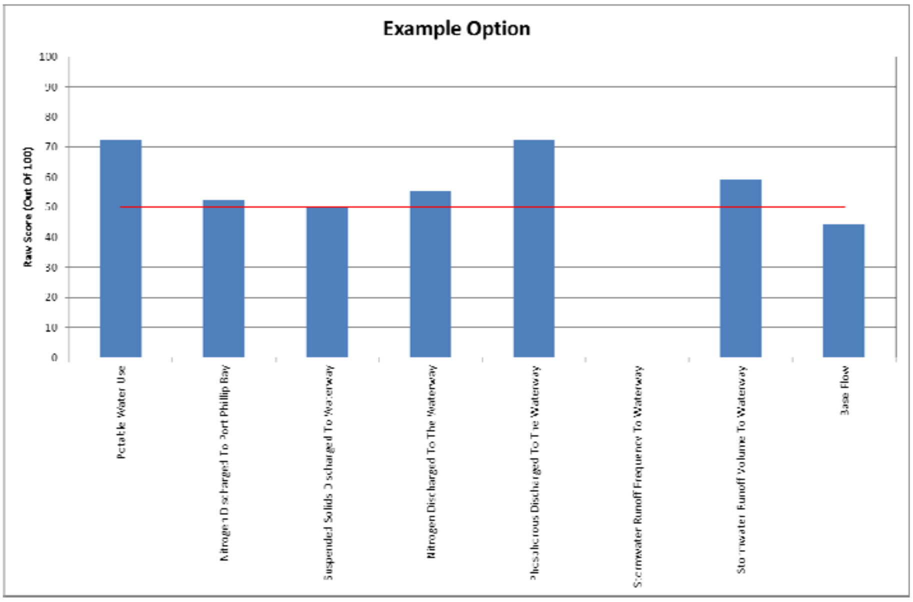

Figure 1: Example of how raw sub-measure scores can be graphically displayed

Figure 2 shows the overall weighted scores for each option. This graph can also be used to display the sensitivity of the sub-measure weightings which can be extracted from the scoring process used to populate the pairwise comparison model.

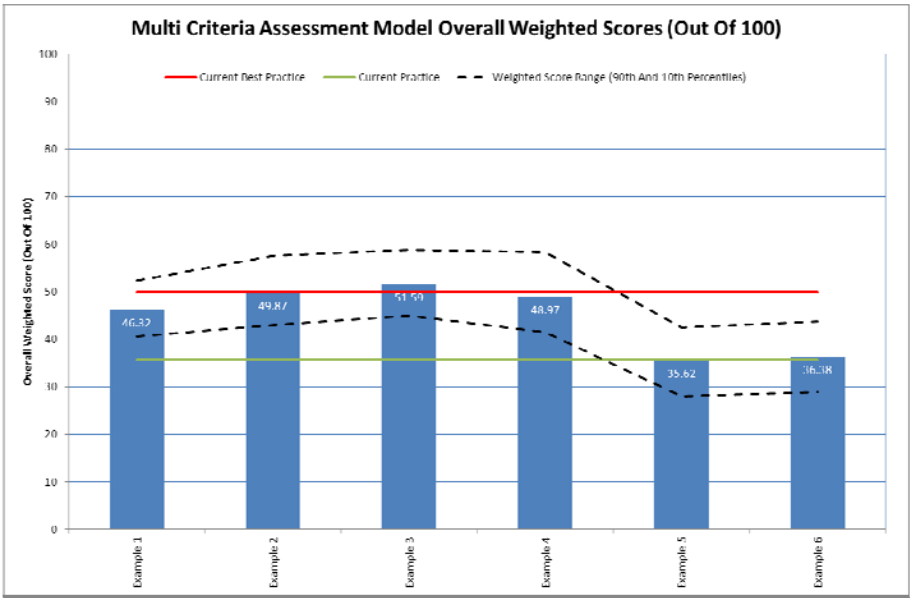

Figure 2 Example of overall weighted option scores from the MCA model including sensitivities

When the overall scores are divided by the Total Community Cost (represented as a Net Present Value), the “community value” ratio is calculated (Figure 3). This ratio effectively measures how much each scoring unit costs the community (i.e. $M of NPC to achieve one unit of MCA score).

In the example below, Option 2 does not have the highest overall MCA but does have the best “community value” and is therefore preferred.

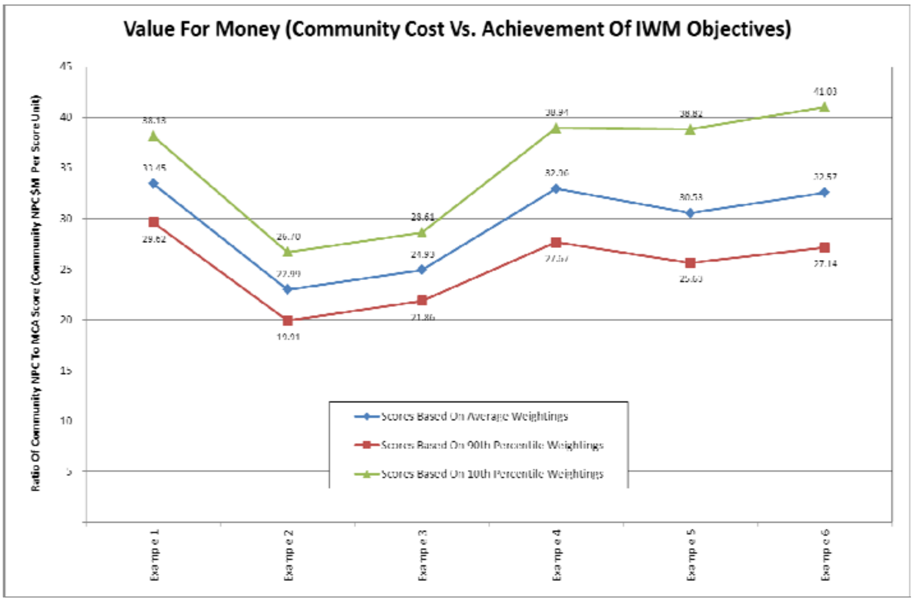

Figure 3 Calculation of a “community value” ratio

<u>CONCLUSION</u>

These results highlight the deficiencies of a traditional Triple Bottom Line (TBL) approach which attempts to consider financial, social and environmental measures in parallel. A community value ratio approach has several points of difference, namely:

- Traditional TBL models often artificially reduce the weighting given to community cost and fail to recognise the commercial reality of how business decisions are made. They can also recommend options which do not necessarily represent value for money (i.e. an option may meet all of the desired objectives but have an huge cost).
- The community value ratio for the “do nothing” option represents a reference point against which alternative options can be compared. Theoretically, this reference point represents “current practice” (not to be confused with current best practice) and before considering alternatives, they should have a matching or better ratio.
- The option with the highest community value ratio may not necessarily have the highest MCA score. Often in traditional TBL models, there is very little difference in overall option scores but large variations in community cost.

Additional outcomes of the study which will be used to inform future investigations of a similar nature included:

- The design of the infiltration system is critical, particularly in heavy clay soils where the evapo-transpiration rate is much greater than the infiltration rate.
- The use of rainwater tanks is very “area” specific. In this study, average reliabilities were between 52-81% depending on household size (with 100% of the roof area connected to the tank and annual rainfall of 596mm).
- The use of rainwater tanks to supply the hot water service in parallel with recycled water for non-potable uses can reduce per capita consumption to 60L/person/day (30L/person/day less than a recycled water only solution).
- In systems where energy intensive supply augmentations such as desalination are in place, the use of recycled water to substitute non-potable uses can result in a significant reduction in greenhouse gas emissions (in this study, recycled water production and supply consumed approximately 2,000kWh/ML compared with 3,500kWh/ML for potable water). For the purposes of comparison, a typical household rainwater tank system uses 2,500kWh/ML.