

# ADAPTIVE PLANNING FOR RESILIENT URBAN WATER SYSTEMS UNDER AN UNCERTAIN FUTURE

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## ABSTRACT

Water planners are familiar with some form of variability in climate and demand. However, the uncertainty associated with the frequency and magnitude of the variations, coupled with broader performance expectations, means that long term deterministic planning needs to give way to a new approach. The structured adaptive planning process proposed in this paper aims to meet those objectives and accommodate the uncertainty in the future by developing a portfolio of measures that are both flexible to gradual changes in trends and robust to sudden shocks. A step-by-step process of the planning framework is presented. This is followed by a case study of the inputs and results based on its implementation by the Melbourne water businesses.

## INTRODUCTION

Historically, water planners in Australia have had a good appreciation of the variability in rainfall, which is one reason why Australia has one of the highest per capita water storage volumes in the world (World Bank 2005). In addition, the challenge of ensuring water security under growing demands has become increasingly significant. The recent droughts experienced in Australia have highlighted this variability of the climate and the water sector's vulnerability to climate change impacts.

In the past, reserve supplies and water restrictions were the default strategy, however more recently water service providers are seeking 'diversified portfolios' and 'flexible strategies' as a means toward providing improved security and resilience at reduced costs. The emergence of this new way of thinking represents a challenge to existing conceptual and analytical models underlying resource planning decisions. It requires a shift from deterministic approaches to an approach that builds in flexibility based on the information at hand and one that delivers much needed information on phasing and sequencing under different circumstances.

Such an approach should identify and deliver flexible and robust outcomes to plan and manage, future uncertainties which may include climate change, population growth, economic activity and unexpected shocks. Further, the multiple values of

water, such as the way in which water contributes to a sustainable, liveable, prosperous and healthy city as well as values attached to individual supply options, should ideally be incorporated into the decision making approach.

A number of advanced methods from finance and decision theory have been suggested in the literature, but these methods are often too complex for practical implementation. An alternative approach is required that translates and situates these methods in the context of water resource planning.

As such, an adaptive planning approach was designed for the development of the next fifty year strategic plan for the Melbourne based water utilities (Mukheibir & Mitchell 2011). It provides a guide for the strategic planning process, and supports operational decisions, in order that the portfolio of investments deliver a resilient water system over the long term.

The paper firstly provides an introduction to the new terms and concepts introduced by the framework, and then discusses methodological steps required to undertake the options assessment process. A case study of the process undertaken and outcomes achieved by the Melbourne water businesses is used to illustrate this process.

## INNOVATIONS INTRODUCED BY THIS FRAMEWORK

This options assessment framework uses a variety of terms and concepts that are relatively new to the water sector. Although these terms are being used more and more frequently, they are at this stage likely to mean different things to different people and within different organisations. The key terms and concepts that make up this framework have specific meanings and are defined in the footers.

This kind of assessment framework is new, and is pushing the frontiers of best practice. Whilst there are various theoretical methods for decision-making under uncertainty, some of which have been applied in other sectors (e.g., finance), they generally have not been applied to the water sector and have not been brought together in an integrated, practically-grounded process to guide strategic planning and project level decisions. As