Chapter 3
Developing a Water Demand Management Plan

3.1 Introduction to a Water Demand Management Plan

WDM policies and interventions are proposed, legislated, regulated, and implemented by various stakeholders,[1] depending on a country, province, or city's context. Although federal and/or local authorities often propose WDM interventions in the form of strategies, master plans, and legislations, measures are often implemented by the water service providers, particularly in urban contexts (Barsugli et al. 2012; Liner and DeMonsabert 2011).

WDM plan formats may vary from one city to another, depending on the governance system, water service providers, and existing water supply provisions. Developing a fit-to-context WDM plan can help inform water service providers how to achieve efficient water use and encourage water conservation, optimising existing resources before considering the creation of additional resources and infrastructure (Maples et al. 2014; US EERE n.d.; Wang et al. 2020).

It is recommended that water service providers have a clear and well-structured WDM plan that succinctly outlines the design response to managing water demand with clarity. The plan may give consideration to analyses, programmes, policies, and also measures of WDM, along with clear definitions of the following: (1) objectives/targets (short, medium, and long term); (2) approach/process; (3) budget; and (4) time frames of implementation (IUCN 2016; Hoffman and Plessis n.d.).

1. Objectives/Targets: Measurable objectives/targets should be set based on the existing water situation in a given context (i.e. supply–demand) and realistic estimates of what can be achieved through the proposed measures, while avoiding conflicting objectives (China Water 2010; IUCN 2016; Mohammad-Azari et al. 2021; Xiao et al. 2018).

[1] Stakeholders are organisations, individuals, groups of individuals, and political entities with an interest in the outcome of a decision (Victoria State Government 2021). In this context, stakeholders are federal and local authorities, commercial sector, and residential water users.

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2. Approach/Process: The WDM plan may include suggestions on the planning approach through a detailed and transparent decision-making process, with clear roles and responsibilities, which can be adapted to varying conditions (EPA 2016).
3. Budget: Adopters may identify the financing arrangement for WDM measures with associated costs on a time frame consistent with the available budget. WDM measures can be evaluated on a cost-effectiveness basis and prioritised based on the greatest potential benefit for the least capital investment (Hoffman and Plessis n.d.; Pacific Water n.d.) or measures that secure significant water savings (refer to Sect. 3.4 of this report).
4. Time Frames of Implementation: Measurable targets may be determined based on established time frames of implementation that are realistic (Hoffman and Plessis n.d.) and that prioritise relevant measures, address immediate needs, and track the progress of implementations (CSE 2017).

3.2 Notable Example of a Water Demand Management Plan: PUB, National Water Agency of Singapore

Singapore's water supply, water catchment, and used water are managed by the Public Utilities Board (PUB), its national water agency (PUB 2021a, b). Presently, Singapore is internationally recognised as a model city for integrated water management, with expertise in water management technologies (PUB n.d.). Forward planning has played a key role in developing Singapore's water infrastructure, where planning instruments such as the 1971 Concept Plan[2] and the 1972 Water Master Plan[3] have set the foundation for long-term water strategies (Tortajada et al. 2013). Through the years, PUB has formulated long-term plans, implemented them promptly, and embarked on an integrated approach to water management, focusing on three key strategies:

- Collect every drop of water.
- Reuse water endlessly.
- Desalinate seawater (PUB n.d.).

Over the years, PUB has directed attention to the growing water demand to ensure that water demand does not rise at an unsustainable rate. Thus, planning has incorporated WDM measures with clearly defined targets, outcomes, and timelines for implementation. This is illustrated in Table 3.1.

To achieve the above, PUB has adopted a multi-pronged approach with several predetermined WDM measures. A summary can be seen in Table 3.2.

[2] Guide to the physical development of Singapore that aimed to ensure the optimal use of limited land resources to meet the residential, economic, and recreational needs of a population that was projected to reach 4 million by 1992 (URA n.d.).

[3] Guide to Singapore's long-term water resource planning that proposed innovations in terms of policies, management, and technology (Tortajada et al. 2013).

Table 3.1 PUB water demand management planning

Focus area	Target	Present outcome	Timeline for implementation
Water consumption	To reduce household water consumption to 130 L/capita/day[4]	In 2019, water consumption/capita/day was 141 L[5]	From 1 January 2022, MWELS[6] was extended to include WC flush valves, and all WC flush valves for sale and supply to be labelled with 2-tick or 3-tick ratings From January 2022, minimum water efficiency requirements for the sale and supply of new commercial equipment (i.e. washer extractors, commercial dishwashers, and high- pressure washers) to be introduced
Water losses	To reduce and minimise water loss in the distribution network	1. As of 2020, PUB has installed 300 permanent leak detection monitoring sensors 2. In 2020, water loss in distribution networks was 8.0%	1. By the end of FY21, install 900 additional leak detection sensors to monitor 500 km (40%) of the transmission pipelines 2. By the end of FY21, review the Digital Master Plan[7] to develop smart technologies 2. 1. Development of a smart water grid for the monitoring of network pressure and leak detection and to improve demand forecasting 3. In the early 2022, commence installation of the first 300,000 smart water meters. This task will be completed by 2023

(continued)

[4] As per the Singapore Green Plan 2030.

[5] Year 2019 was chosen as water consumption in 2020 was affected by COVID-19 and lockdowns (e.g. people spent longer hours at home).

[6] Mandatory Water Efficiency Labelling Scheme. Since July 2009, suppliers have been required to label the water efficiency of their water appliances on all displays, packaging, and advertisements under the MWELS. It follows a grading system with a '0/1/2/3/4'-tick rating to denote water efficiency (PUB representative in the ASEAN Working Group on Water Resources Management. Email interview, 7 March, 2022).

[7] Refer the PUB Sustainability Report FY20/21, page 55. https://www.pub.gov.sg/Documents/Publications/PUB_SustainabilityReport.pdf.

Table 3.1 (continued)

Focus area	Target	Present outcome	Timeline for implementation
Water conservation	Continue to educate and engage various stakeholders through different platforms and modalities to create greater awareness and encourage personal action towards water saving	1. Engage with consumers through various social media platforms: 1. 1. Water conservation campaigns such as, the 'the climate is changing', Singapore world water day (SWWD), #GoBlue4SG movement (FY20) 1. 2. Introduce water-related topics in the school curriculum to deepen knowledge of water sustainability, conservation, and water-saving habits (ongoing) 2. Develop benchmarks and setting standards: launched the Singapore green labelling scheme (SGLS) for commercial water-use appliances (FY20)	Continues engagement and education of various stakeholders on the importance of using water wisely
Alternative water supply systems	To continue to ensure there will be enough water for all for present and future uses	1. 100% population served by tap water supply (FY21) 2. The Keppel Marina East desalination plant opened on 4 February 2021 (capable of producing 137,000 m^3 of fresh drinking water per day) 3. Supply and distribution of NEWater, a highly treated reclaimed water for both potable and non-potable purposes 4. Encourage innovative water recycling solutions through funding schemes, e.g. industrial water solutions demonstration fund (IWSDF) (part of the water efficiency fund) and the national research foundation's (NRF) living laboratory (water) fund	Ongoing works for the Changi NEWater Factory 3 and deep tunnel sewerage system phase 2. The projects are set to be completed by 2023 and 2025, respectively

Source PUB (2021a, b, n.d.), PUB and Keppel Corporation (n.d.)

Table 3.2 Summary of water demand management measures in Singapore

Measure	Implementation
Water loss	• Rigorous and preemptive leak detection programme • Pressure monitoring • Pipe replacements • Smart technologies for leak detection • Metering
Economic instruments	• Increasing block tariff (IBT) mechanism including water tariff, Water Conservation Tax, and waterborne fee
Non-price mechanisms	• Public education campaigns, for example: – 'Let's not waste precious water', 'use water wisely', 'turn it off. Don't use water like there's no tomorrow', 'SAVE water', 'make every drop count', 'clean water begins with you', #GoBlue4SG • Educational programmes in schools: inclusion of water-related topics in the curricula • Water efficiency measures and awards – Singapore green labelling scheme (SGLS), water closet replacement programme, water efficiency awards, water efficiency management practices (WEMP), Mandatory Water Efficiency Labelling Scheme (MWELS)

Source PUB (2021a, b, n.d.)

Singapore's success in water management is grounded in its comprehensive planning systems, where water has been integrated into the city-state's overall development plans, including urban development (Lafforgue and Lenouvel 2015; Tortajada et al. 2013). Through the years, PUB has formulated long-term plans, with clearly defined targets that have been implemented on a timely basis. Quantifiable targets have been set based on the existing water situation and realistic estimates of what can be achieved through the proposed measures (Chen et al. 2011; Lafforgue and Lenouvel 2015).

3.3 Steps to Developing a Water Demand Management Plan

By developing a strategic and comprehensive WDM plan, water service providers can set out specific water-use reduction targets to achieve water conservation goals and seek greater water efficiency through defined targets (CDWR n.d.; EPA 2015; Kiefer and Krentz 2018; US EERE n.d.).

In general, developing a WDM plan involves the following steps:

- Situation analysis. Reviewing existing policies, regulations, water trends, flows, and demands through data collection and analysis.
- Identifying water management constraints and opportunities. Evaluating the implementation of existing WDM measures and identifying applicable WDM

measures where options may be prioritised based on costs, water-saving potential, social acceptance levels, and impact on the water supply–demand balance.

- Undertaking economic analyses of WDM options through various methods, such as cost–benefit analysis[8] and multi-criteria analysis.[9]
- Setting WDM objectives/targets: clear quantitative indicators to measure performance and progress. Possible indicators may include
  - Rate of non-revenue water (NRW).
  - Levels of metering.
  - Unit operations and maintenance costs.
  - Total water consumption.
  - Trends in leakage reduction.
  - Percentage of cost recovery.
- Selecting and prioritising WDM options: screening measures for applicability, feasibility, and acceptability.
- Developing the WDM plan.

Sources CSE (2017), IUCN (2016), Pacific Water (n.d.), US EERE (n.d.).

As discussed, WDM plan formats may differ from one city to another, depending on the governance system, water service providers, and existing water supply provisions. Thus, the steps to developing a WDM plan may also vary based on the governance and water provision context. Table 3.3 provides an overview of selected guidelines to develop a WDM plan for implementation in countries, such as India, France, South Africa, and the USA.

3.4 Notable Example of Water Demand Management Planning

Figure 3.1 highlights a phased, nine-stage approach for a WDM strategy, starting with the collection and verification of data and culminating in the implementation and evaluation of the effectiveness of strategies in place (Pacific Water n.d.).

The guideline is developed by the Pacific Community, an international development organisation that generates research on topics such as water, sanitation, and fisheries science (Pacific Water n.d.). It serves as a support tool for local water service providers, practitioners, and consultants involved in developing and implementing WDM plans. The nine-stage approach demonstrates how water service providers can develop and implement a feasible WDM plan to achieve WDM targets through a step-by-step method. It provides a comprehensive and integrated approach to WDM planning that has been developed for implementation in water-scarce countries

[8] Process to assess monetary values (all costs and benefits) associated with certain measures, decisions, or projects (FAO n.d.; Smart Water Fund 2011).

[9] Process to assess certain decisions, measures, or projects based on multiple objectives and criteria (or attributes) (Dean 2020).

Table 3.3 Overview of selected guidelines to water demand management planning

Source	Description	Developed for the context of	Summary of steps/phases to developing a WDM plan
International Union for the Conservation of Nature (IUCN) (n.d.) IUCN is a membership union composed of both government and civil society organisations. It produces a range of publications, databases, and guidelines for conservation and sustainable development-related topics	The guideline serves as a decision-making support tool for local authorities and water service providers. It provides a detailed stepwise approach to developing a WDM plan	South Africa	1. Situational analysis • Collect and verify water trends, flows, and demand • Identify main water user groups 2. Identify critical water use, supply, management concerns, constraints, and potential opportunities 3. Identify various integrated water resource management options including opportunities to increase non-conventional supplies (i.e. desalination and rainwater harvesting) 4. Formulate detailed and time-bound WDM targets appropriate to the local situation 5. Analysis of WDM options using multi-criteria analysis or cost–benefit analysis 6. Select and prioritise WDM options based on preliminary analysis 7. Determine budget allocation for implementing measures and to identify potential funding opportunities 8. Develop the WDM plan, including targets, measures to be implemented, financial requirements, and a monitoring and evaluation component Key guideline recommendations: • Periodic evaluation and continuous assessment of measures after implementation that would allow for regular modification of the WDM plan, if necessary • Clear quantitative indicators to measure progress and ensure targets are being met (e.g. rate of non-revenue water [NRW], levels of metering, total water consumption). This is crucial as different stakeholders involved in WDM implementation in urban contexts may interpret performance differently

(continued)

Table 3.3 (continued)

Source	Description	Developed for the context of	Summary of steps/phases to developing a WDM plan
Centre for Science and Environment (CSE) (2017) CSE is a public interest research and advocacy organisation. Its research focuses on environmental issues relating to air, water, waste, and energy	The water efficiency and conservation guideline incorporates measures for developing a WDM plan. The guideline is targeted to stakeholders of urban local bodies, municipal corporations, NGOs, higher learning institutes, and private organisations with an interest in water efficiency planning	India	1. Situational analysis. Collect and verify water trends, flows, and demand data. Review existing policies and regulations related to water conservation and management 2. Set measurable and time-bound goals based on the situational analysis 3. Develop a plan by identifying various water conservation measures, determining feasibility level, and estimating cost and benefits of measures 4. Prioritise measures and develop a strategy for implementing the WDM plan. Involve all relevant stakeholders through the planning process 5. Evaluate and modify the plan based on regular assessments after implementation Key guideline recommendations: • ‘Situation-driven’ approach to planning and consideration of the local context. This may include a review of current policies and regulations and estimation of water trends through data and analysis • The broad involvement/participation of stakeholders in developing the plan ensures that alternative solutions serving a diverse range of interests are considered through a multi-perspective approach to planning

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Table 3.3 (continued)

Source	Description	Developed for the context of	Summary of steps/phases to developing a WDM plan
Tampa Bay Water (2018) Tampa Bay Water is a regional water service provider. It supplies drinking water to water users in Tampa Bay, Florida	The guide is aimed at local urban households, industries, authorities, and other water service providers interested in implementing a water demand management programme	USA	1. Formulate WDM objectives and targets 2. Economic analysis of WDM options to determine cost–benefit ratios 3. Screen and rank the most appropriate WDM options in accordance with WDM objectives (e.g. by water-saving potential, costeffectiveness, public acceptability, administrative feasibility, etc.) 4. Undertake water demand forecast scenarios to assess future demand scenarios 5. Select the most appropriate WDM measures for implementation Key guideline recommendations: • Regular monitoring and evaluation of WDM plans and measures to support long-term water supply plans • Work with local government authorities to develop WDM implementation strategies consistent with the local requirements. Strategies may have a specific focus on water users or in areas where there is an opportunity to increase conservation efficiency

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Table 3.3 (continued)

Source	Description	Developed for the context of	Summary of steps/phases to developing a WDM plan
Dutreix et al. (2014) This guideline was developed on behalf of Plan-bleu, one of the Regional Activity Centres of the United Nations Environment/Mediterranean Action Plan and put in place by France since 1977	This guideline is for decision-makers and managers, local authorities, and water service providers. It is a decision-making support tool that analyses various WDM measures through a methodology which characterises, assesses and ranks WDM measures	France	1. Establish an inventory based in the local context • Define the area's geographical and hydraulic conditions • Identify local WDM policies and measures 2. Identify the short, medium, and long-term objectives and prioritise the needs of all user categories and the natural environment (e.g. increased demand, seasonal variation, etc.) 3. Identify the WDM measures already in place and preselect appropriate WDM measures through various analyses, e.g. multi-criteria analysis, SWOT analysis,[10] etc. 4. Assess each preselected WDM measure through a cost–benefit analysis 5. Use indicators to determine which WDM measures to implement (e.g. performance indicators or results indicators) Key guideline recommendations: • Establish a monitoring and assessment system to regularly evaluate the WDM measures implemented • The frequency of data analysis should not be too high (processes may have restrictive time limits or high costs) nor should it be too low (data must be able to reflect potential seasonal factors, such as variation in climate conditions or peaks of activity in some sectors)

Source IUCN (n.d.), CSE (2017), Tampa Bay Water (2018), Dutreix et al. (2014)

[10] Tool for assessing strengths, weaknesses, opportunities, and threats of a particular measure, decision, or project (Gürel 2017).

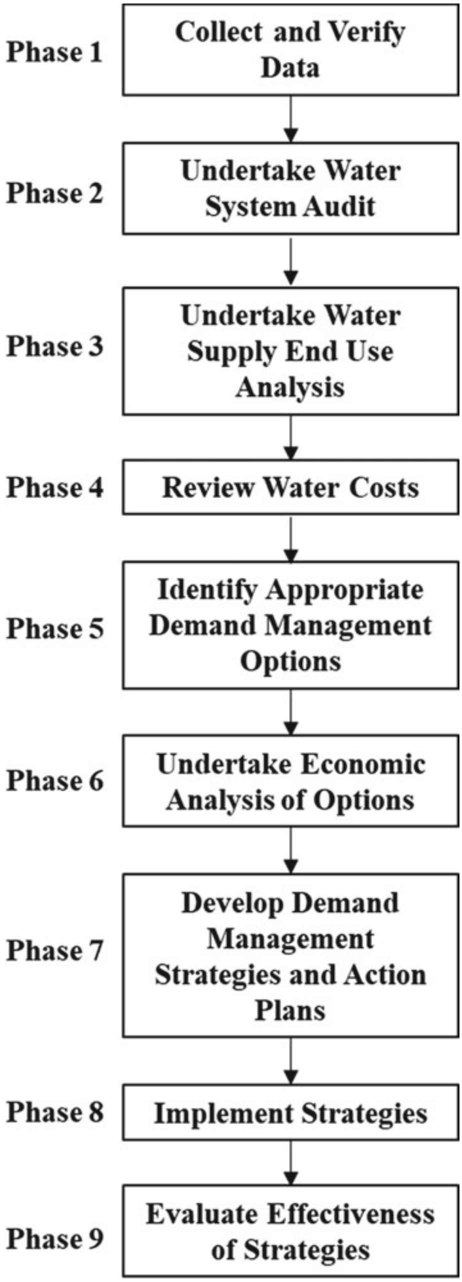

Fig. 3.1 Water demand management process. *Source* Pacific Water (n.d.)

such as Australia[11] (Pacific Water n.d.). In addition, this considers several aspects of relevance to water service providers for WDM planning and implementation, such as system audits, end-use analyses, and economic assessments. This example also acknowledges the valuable role of broad stakeholder participation in providing feedback to water service providers in the WDM planning and implementation process.

The water demand management process involves the following:

Phase 1: Collect and verify data to identify critical constraints and opportunities. This can include collating information related to

(a) Bulk meter readings within the water network.
(b) Wastewater flows and assessments.
(c) Rainfall estimates.
(d) Prior information on leakages within the network.
(e) Daily flow trends of the water system.
(f) Existing information gaps.

Phase 2: Undertake a water system audit. This would help assess all water flows within the system. As a water audit can track water loss by identifying and quantifying potential leaks, it may be followed by a meter testing and calibration programme. Water service providers may also undertake customer and operational investigations for potential leaks or unauthorised consumption (theft) to prevent (further) loss of revenue (EPA 2015; Pacific Water n.d.;Van Arsdel 2021). A preliminary top-down[12] water audit may be conducted as follows:

(a) Identify the amount of water added to the system (typically for one year).
(b) Identify authorised water consumption (billed + unbilled water).
(c) Calculate water losses (water losses = system input − authorised consumption) (CSE 2017; EPA 2015).

Phase 3: Undertake a water supply end-use analysis. This may include the following:

(a) Identifying customer use profiles and water usage patterns.
(b) Identifying customer water demand trends (i.e. number of connections versus consumption range) (Pacific Water n.d.; US EERE n.d.).

Phase 4: Review operational and maintenance-related costs (Pacific Water n.d.; US EERE n.d.)

Phase 5: Identify appropriate water demand management options by selecting and prioritising options based on measure applicability, feasibility, and acceptability

[11] Australia represents a case study of 'good' WDM practices. Despite the Millennium Drought (1997–2012) that affected most of Southern Australia as well as an increase in the national population, the water consumption levels have declined since 2012 (Government of Australia 2019). This suggests that Australia's WDM plans and measures, implemented in response to the Millennium Drought, had a strongly positive effect on water consumption and habits.

[12] A water audit is initiated at the 'top'. As it is based on existing information and records, additional fieldwork is not required (EPA 2015).

(CSE 2017; McDonald and Mitchell 2019; Rathnayaka et al. 2016; Victoria State Government 2021). The appropriate amount of water demand measures may vary, depending on the governance structure, level of development, and the degree of water scarcity in each city (Global Water Partnership 2012).

Options may be prioritised according to their (a) water-saving potential; (b) social acceptance; and/or (c) impact on the supply–demand balance.

(a) Water-saving potential refers to the total amount of water saved by different water user groups, which may vary considerably in accordance with the WDM measure in question (Pacific Water n.d.; Wang et al. 2020). To determine the water-saving potential of a given WDM measure, a prioritisation analysis of WDM measures can be undertaken by governments and/or water service providers to determine and select the most sustainable WDM options (Bello-Dambatta et al. 2013; Rathnayaka et al. 2016).

(b) Social acceptance refers to a collective consensus of stakeholders and institutional feasibility for the implementation of WDM measures (Butler and Memon 2006). It includes the impacts on society through public perception, politicisation, individual acceptance, and use adaptation (Al-Saidi 2021; Rathnayaka et al. 2016). Despite some WDM measures being more socially acceptable than others, an absolute level of social acceptance for each WDM measure has not been established (CSIRO 2010).

Effective public education and awareness campaigns, such as public communications through the media (Tortajada and Nambiar 2019), as well as social norms,[13] can influence the social acceptance and public opinion of WDM measures (Lede and Meleady 2018). The social acceptability of WDM measures may also increase when there is a need to reduce water use, such as in times of drought (Bello-Dambatta et al. 2013).

(c) Impact on the supply–demand balance refers to the influence that WDM measures can have on the supply of and demand for water. The current supply and demand of water is influenced by the availability of freshwater and impacts of climate change (Gosling and Arnell 2016; Lede and Meleady 2018). This includes extreme hydrologic events such as droughts, floods, typhoons, and cyclones that create uncertainties about traditional sources of water supply (e.g. freshwater), (Bello-Dambatta et al. 2013; Bloetscher et al. 2014; Xiao et al. 2016).

At the same time, urbanisation, rapid population growth, and competing water uses (domestic, commercial, and industrial) also affect water demand (Chen and Trias 2020; Cousin et al. 2019; Hartley et al. 2019; Subramanian 2019). Identifying and assessing the potential impact of these influences over the existing supply–demand balance can enhance the decision-making process (Smart Water Fund 2011).

[13] Social norms are signals that can help people make sense of social situations, particularly in terms of the expectations of people's behaviour, by guiding or constraining human behaviour. This social influence approach is increasingly being used by water service providers and related organisations to encourage 'green' behaviour (Lede and Meleady 2018).

To maintain the water supply–demand balance and safeguard the security of future water supply, an array of WDM measures can be implemented. As different WDM measures will have different impacts on the supply–demand balance, governments and water service providers can assess and determine which WDM measures are appropriate for certain areas as well as which WDM measures will improve the water supply–demand balance (Rathnayaka et al. 2016; Victoria State Government 2021). If it is deemed that water demand must be reduced, then other factors, such as cost-effectiveness, may need to be adjusted accordingly to facilitate this (Bello-Dambatta et al. 2013).

Phase 6: Undertake an economic analysis of options.

Reliable estimates of water consumption and operational costs are necessary to evaluate this consideration. An economic analysis of options can be undertaken to guide the prioritisation of options. The chosen approach to an analysis of this kind should be bespoke to the initiative being considered (CSE 2017; Pacific Water n.d.; Victoria State Government 2021).

(a) Cost–benefit analysis (CBA). CBA is the most widely recognised economic tool by public and private sector organisations for the evaluation of investments or to appraise the desirability of certain measures, decisions, or projects. It involves identifying the monetary values for all costs and benefits associated with these measures, decisions, or projects (FAO n.d.; Smart Water Fund 2011).
With the objective of maximising the value of benefits received, CBA can help to determine whether benefits outweigh costs over a given period of time[14] (t) and by how much (Hoffman and Plessis n.d.; Malm et al. 2015; Smart Water Fund 2011). This may be supported by a proposed timeline for the implementation of these WDM measures along with the rationale for adopting the measure (Victoria State Government 2021).
(b) Unit Reference Value (URV). As certain costs and benefits associated with WDM measures may be difficult to quantify, an alternative method of assessing economic efficiency is the Unit Reference Value (URV). This measure was specifically developed to evaluate projects/measures in the water sector (Hoffman and Plessis n.d.; Niekerk and du Plessis 2013). The present value (PV) of the water supplied is calculated by projecting the value of water supplied over a stipulated period of time and discounting it at a predetermined rate (r). The same approach is employed to calculate the PV of costs.[15]

According to this approach, costs refer to those directly related to the quantity of water delivered.[16] The URV can then be calculated by dividing the PV of all

[14] To take into account the time value of money.

[15] These costs are determined at constant prices and adjusted to exclude any taxes and subsidies (Niekerk and du Plessis 2013).

[16] E.g. costs due to water pumping, water transportation, water treatments, etc. (Niekerk and du Plessis 2013).

costs incurred by the PV of the quantity of water supplied[17] (Niekerk and du Plessis 2013). The yield can be calculated on an annual basis. As part of the decision-making process, the URVs of different WDM measures may be compared and prioritised based on the lower URV values.

Phase 7: Develop demand management strategies and action plans that describe key stakeholders' roles, responsibilities, and funding sources, consistent with statutory regulations and stakeholder vision (Kiefer and Krentz 2018; Smart Water Fund 2011; US EERE n.d.). Involving stakeholders in WDM planning serves the dual purposes of generating a feedback mechanism between water users and water service providers, while also educating water users on efficient water use (CSE 2017). Where action from external parties may be required, negotiations may be completed by this stage.

Phase 8: Implement strategies against pre-defined targets. The implementation process can include

(a) Short-term strategies for immediate implementation and prompt visible impacts (McDonald and Mitchell 2019; Wang et al. 2020).
(b) Long-term strategies for implementation over a longer stipulated period (China Water 2010).

Phase 9: Evaluate the effectiveness of strategies through regular monitoring and evaluation arrangements. Designate a unit dedicated to monitoring and evaluation. Annual reviews may be undertaken to assess the effectiveness of the implementation of WDM measures. This would allow certain approaches to be brought forward or deferred, based on the evaluation or new information (Pacific Water n.d.; US EERE n.d.; Victoria State Government 2021).

3.5 Key Takeaways

1. Developing a coherent and well-structured WDM plan, that is fit-to-context can help water service providers achieve more efficient water use by optimising existing resources before considering the creation of additional resources.
2. A fundamental aspect of the WDM planning and implementation processes is the inclusion of stakeholders and, in particular, stakeholder feedback. This can help improve communication and coordination between the parties involved in these processes. For water service providers in ASEAN cities, attending to stakeholder opinions (e.g. federal local authorities and residential and non-residential water users) on WDM measures can help better address both the present and future needs of water users through a multi-dimensional approach to planning.
3. For ASEAN cities, a holistic nine-phase approach to WDM planning is recommended. By starting with the collection and verification of data (first step) and

[17] URV = PV of costs/PV of quantity of water supplied (Bester et al. 2020; Niekerk and du Plessis 2013). A graphic illustration of the URV is shown in Appendix A.

culminating in the implementation and evaluation of the WDM measures in place, the method demonstrates how the design objectives can be met.

4. To further support the WDM implementation process, it is recommended that there is monitoring and assessments of the WDM measures once they are in place. Regular evaluations of the WDM ensure that they can adapt to the changing conditions and remain effective. For ASEAN cities, this may take the form of, for instance, annual or 6-month reviews by water service providers or the establishment of a WDM unit within the water ministry/water resources department of the local government to coordinate with water service providers.

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