water

MDPI

Review

A Review and Comparative Analysis of IWCM Concepts in Australia and Similar Jurisdictions

Tasneem Rangwala *, Pierre Mukheibir and Simon Fane

Institute of Sustainable Futures, University of Technology Sydney, Sydney 2007, Australia
* Correspondence: tasneem.rangwala@student.uts.edu.au

Abstract: Interpretations of integrated water cycle management (IWCM) differ across jurisdictions. This paper discusses 10 interpretations of the IWCM concept globally, in Australia and in jurisdictions similar to Australia. Five interpretations of many IWCM versions in Australia are reviewed. This strategic concept aims to address the internal challenges of managing water demand and supply, achieving appropriate disposal and/or wastewater recycling for re-use and distribution networks and providing services at an affordable rate, per changing community needs. The IWCM concept is also recognised as a resource planning tool to address external challenges, such as the uncertainties of climate change, the circular economy and resilience. All 10 IWCM concepts reviewed in this paper acknowledge governance and stakeholders to be of primary importance: governance to drive the conceptual interpretation and stakeholders to develop, drive, implement and promote IWCM as adept at addressing local challenges. The two global interpretations place primary importance on governance, stakeholder engagement and natural resource management, whereas the local interpretations place equally high importance on water critical infrastructure and water economy. Technology, which is changing at an unprecedented pace, is considered, but not as an immediate or primary challenge. These differences are mainly attributed to the organisations' responsibilities and constraints, which drive IWCM concept design.

Keywords: integrated water cycle management; integrated water resource management; urban water planning; regional water planning; challenges; review; comparative analysis

check for updates

Citation: Rangwala, T.; Mukheibir, P.; Fane, S. A Review and Comparative Analysis of IWCM Concepts in Australia and Similar Jurisdictions. *Water* **2023**, *15*, 1369. https://doi.org/10.3390/w15071369

Academic Editors: Athanasios Loukas and Carmen Teodosiu

Received: 21 February 2023
Revised: 14 March 2023
Accepted: 17 March 2023
Published: 3 April 2023

1. Introduction

The World Bank [1] identifies the importance of equal access to clean water in its Environmental and Social Framework Report, and it is also Sustainable Development Goal 6 [2]. This problem of unequal access to safe and clean drinking water is compounded by prolonged and frequent droughts, climate-change-induced flooding and a linear water management approach [3]. Zbynek Hrakal notes that 96 percent of countries have sufficient water resources, so the problem lies not in physical water scarcity but in water mismanagement, a lack of education and poverty [4]. Mukheibir [5] also finds that poor access to water is often confused with physical water scarcity and that it is widely perceived as the key feature undermining water security. The extreme and complex nature of managing water resources across political and geographical boundaries adversely impacts long-term strategic planning design to achieve water security [6].

The need for equitable access to clean water is more pronounced than ever [7]. The COVID-19 pandemic brought to our attention that a lack of clean water access and basic living conditions were major and adverse contributors to containing the pandemic, especially for developing countries with very high population densities [7,8].

The World Bank Report 'High and Dry: Climate Change, Water and the Economy' predicts that almost one-quarter of the world's population (1.6 billion) suffers from [9] significant water scarcity and excessive variability, and these numbers are predicted to double by 2036. Furthermore, [9] the world may face a shortfall in water availability of approximately 2700 billion cubic metres by 2030, with demand exceeding current sustainable water supplies by 40 percent.

The demise of several civilisations has been traced directly to failed regional water management, for example, Peru and Mesopotamia [10,11]. Successful water resource planning (WRP) has also led to the economic turnaround and growth of areas, for example, the Tennessee Valley Authority (TVA) [12]. The TVA integrated the functions of navigation, flood control and power production while addressing the issues of erosion control, recreation, public health and welfare, which led to its economic turnaround and participation in President Roosevelt's New Deal initiative aimed to rescue the US economy from the Great Depression [13]. Such is the impact of good water resource planning. The need to address the issue of equitable access to clean water has been, is and always will be immediate.

Traditional urban water management practices perpetuate a linear (one-way) use of water, from sourcing it to treating it to polluting it through diverse uses before it is discharged downstream [14]. Contemporary water practitioners also acknowledge that the concept of integrated urban water management is not new. These practices have been adopted and documented informally to achieve the best practice water management outcomes.

Integrated water cycle management (IWCM) arises from the need to meet the complexities of water demand and supply requirements under the many and multifaceted challenging conditions of resource constraints and uncertain environments. IWCM emerged in the 1950s to manage these complex water management challenges [15], and the first known example of a successful IWCM is the 'Integrated River Basin Development' by the Tennessee Valley Association [16]. Global Water Partnerships (GWPs) formally defined IWCM as integrated water resource management (IWRM) in 2000, which included equitable water distribution and sustainability principles. According to Snellen [13], the IWRM concept is a useful framework for broadening water resource management approaches. For example, Gun [17] notes the recognition of IWRM as a solution to address the complexities of water resource management in a local context.

Long-term strategic planning under the banner of IWCM is complex and has many multifaceted challenges. These challenges have been noted to widely vary according to resource capacity, namely, labour and finance; governance [2,18,19]; geographical area; a continuously changing population density; diversity in community expectations; and the acceptance of solutions [20,21]. Other challenges noted in rural–regional New South Wales (NSW) are resource deficiency, financial constraints, capacity limitations and the ability to allocate dedicated resources. These challenges also include gathering intelligence and data; transforming data into knowledge; and managing, interpreting and analysing the large data quantities required to develop an IWCM strategy for a local water utility (LWU). Although IWCM has been accepted as a solution to address water management challenges, the ambiguities around the individual components at operational levels have proven to be extremely difficult to address. According to a recent Performance Audit Report by the Audit Office of NSW, only one IWCM strategy has been approved as 'sound and ready to commence' by the NSW Department of Industry from a total of 92 LWUs [6].

The contemporary concept of IWCM has been formulated and implemented in diverse ways in different jurisdictions and across countries. Each country emphasises and integrates different water management aspects, moving away from the traditionally linear water management processes towards a closed-loop solution of water treatment and including stormwater as a source of supply. IWCM is implemented to improve the current 'Levels of Services (LoS)' in economically strong countries.

With many diverse views and findings, how can water best be managed to ensure equal access to clean and safe water, and to what extent can IWCM contribute to overcoming water management challenges? What is it that IWCM and its various interpretations currently address? How does it compare across jurisdictions? How might we fill the gaps? These questions are pertinent to developing an 'implementable' IWCM strategy for an LWU in NSW within the institutional boundaries of water authorities and for water resource planners.

IWCM has been explored at global, national, state and regional levels. The concept of IWCM has many interpretations. To further understand how the concept has been interpreted and implemented in a local context, this study examines 10 such interpretations in Australia and similar jurisdictions. The IWCM concept is referred to as 'IWRM' by GWPs and 'Water-Wise Cities' by the International Water Association (IWA) on the global scale, as 'IWCM' in Australia, as 'One Water' and 'Total Water Management' (TWM) in the United States (US) and as 'Water Framework Directive' (WFD) in Europe and European countries. These 10 interpretations are reframed in the adapted framework 'Social, Technological, Economic, Environmental, Political and Infrastructure' (STEEPI) (Figure 1) to enable a consistent comparison and to identify variations in these interpretations.

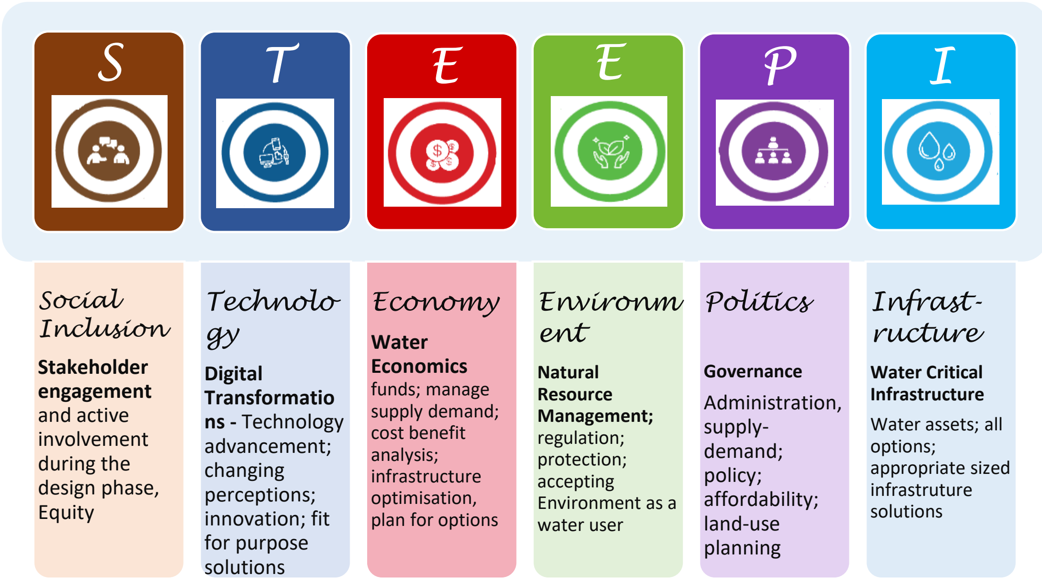

Figure 1. Adapted STEEPI framework definition.

2. Materials and Methods

To explore and compare current IWCM practices, the commonly used 'Social, Technological, Economic, Environmental, and Political' (STEEP) framework was adapted to derive six IWCM categories termed STEEPI (see Figure 1), with an overview of each category. The sixth category of infrastructure, categorised as water critical infrastructure (Water CI), was added as a result of findings from an earlier paper on IWCM in rural–regional NSW [22]. All 44 workshop participants in this research mentioned that future-proofing water infrastructure, which can adapt to changing needs with minimal intervention, is a major challenge and compounded by the ever-changing technological advancements and innovations. Water CI was noted by most participants as the primary responsibility of the Asset Management Teams in the rural–regional councils of NSW, Australia.

The STEEPI framework, as adapted for an IWCM concept, is defined as follows:

- Social inclusion relates to stakeholder engagement, social learning [23], equity [24] and affordability. It allows for collaboratively addressing difficult problems, especially in water governance measures for an IWCM concept [25].
- Technology addresses the challenges and barriers of implementing new systems in a continuously evolving digital environment and in an environment that is high on innovation and lacking in the acceptance of new innovative technology. Innovative technology that has the capability to identify and implement a fit-for-purpose solution that can adapt to changes in land use and population densities is required [26].
- The economics of water management is broad and requires due diligence to procure funds and to conduct options analyses for fit-for-purpose/flexible infrastructure optimisation, Water CI planning and water asset management. It also addresses the economic value of water resources and the society in question. Financing water

management programs is a struggle due to the exceptionally expensive and complex networks of water supply systems [27]. Managing water economics is a complex and multi-pronged challenge, particularly regarding continuously changing population densities and exponential urban growth [28].

- The environment is now recognised as a legitimate water user. Including environmental waters in legal frameworks is a huge leap towards protecting water for the environment, allowing water managers to allocate water for environmental use. These environmental uses include maintaining flows in watercourses to maintain their health and to support life before allocating water for human needs [29–32].
- Politics has a major influence on our society and has the power and authority to initiate a cause or to support a cause as per community demands. The causes driven by the constituent communities, through their political leaders, are referred to as the 'hydro-social cycle': a concept that connects science, people and power [33,34]. The impact and importance of political support for any major water infrastructure is critical and must be driven by communities and translated into strategies by political leaders.
- Infrastructure is defined by the Institute of Civil Engineers in the United Kingdom and cited by Raven [35] as the physical assets underpinning transportation networks, energy generation and distribution, electronic communications, solid waste management, water distribution and wastewater treatment. Critical infrastructure (CI) is defined by Greenberg [36] as the public and private assets required for society and the economy to function. Adverse human interventions, climate variability, unplanned interruptions and technological failures pose risks to Water CI and its dependent systems [37]. Infrastructure is so ingrained as a part of our sustenance that it is essential that we address water infrastructure not merely as 'infrastructure' but as 'critical infrastructure'. Our sustainability efforts, therefore, must include novel measures to address system adaptability to future changes and infrastructure robustness for longer life cycles [38].

The existing conceptual IWCM interpretations were classified and colour-coded into six STEEPI categories: (1) social inclusion, (2) technology, (3) economy, (4) natural resource management (NRM), (5) governance and (6) Water CI—as presented in Figure 2. Figure 2 is used as a template to re-interpret, analyse and illustrate the nine IWCM interpretations discussed in this paper.

Figure 2. Six categories of STEEPI framework.

The 10 IWCM concepts reviewed through the STEEPI framework were derived from economically advanced countries, namely, the US, European Union (EU) countries and

Australia, and global interpretations. Developing countries were not included in this review, as the issues and challenges differ from those of developed countries, especially in their dependence on external funding and support [39].

3. Results and Discussion

The first Global IWCM interpretation, as defined by GWP, is referred to as IWRM. The IWA refers to its version of IWCM as Water-Wise Cities. In the US, the concept that addresses water challenges and is aligned with IWCM is One Water. The TWM in the US is an implementation planning tool developed with the aim of providing better water services at affordable prices [40]. In the EU, WFD is a step towards a single system of managing an entire river basin and is viewed as a form of IWCM [41]. In contrast, in Australia, IWCM is implemented at the local utility level with a specific focus on stakeholder involvement and liveability by Water Services Association Australia (WSAA), least-cost options identified by the Productivity Commission (PC) for an infrastructure option that is appropriately sized and provides high service levels [42], and the Urban Water Cycle Planning Guide (UWCPG) designed by Barwon Water is a tool to develop an implementable IWCM strategy.

Each interpretation is reviewed as per the STEEPI framework in Sections 3 and 4 and their subsections. Following the discussions, re-analyses of all 10 IWCM frameworks are carried out in Section 4.6 to understand the differences in the approach taken by the region to address local problems.

3.1. Integrated Water Resources Management—Global Water Partnership initiative

GWP was founded in 1996 to foster IWRM, defined as a 'process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems' [43]. In August 2019, GWP launched 'GWP Strategy 2020–2025' to mobilise, prioritise and address international water issues.

IWRM-GWP's organisational context and objectives are designed to guide global water governance and management systems. This global governance and management system focuses on creating stakeholder awareness of equitable access to water, health and hygiene; water affordability (pricing); water efficiency; and the environment as a water user [44,45]. This global IWRM-GWP initiative provides a framework, adapting to the specific needs of the region for which an IWRM is developed. The IWRM-GWP interpretation is categorised into three of the six STEEPI categories: (1) NRM, (2) social inclusion and (3) governance (Figure 3). The next level down depicts the categories extracted from Kenabatho [44]: (1) affordable and safe water supply services, (2) the environment—as a water user, (3) efficient water use, (4) education, (5) integrated health and (6) integrated people [43,45].

IWRM-GWP promotes IWRM as a process for improving water governance and management [46]. IWRM focuses on people-centric planning addressing poverty and promotes hygiene and education by undertaking extensive consultations. Regulations, institutional frameworks and finance are not addressed and are assumed to be addressed by the organisations' understanding and interpretation of what an IWRM framework should be. A study by Dinar [47] found that regulations, socio-economics and financial viability are the key drivers to any major program design and implementation. The decision to address their management lies with the responsible authority and is aligned with the IWRM-GWP's conceptual framework.

From a global perspective, it matters little where the funds are procured from or how the local environment is protected and managed—or even the how, where, what, why and when the 5 'W' questions of the local Water CI are addressed—for IWRM strategic planning and implementation. Thus, IWRM focuses on NRM, social inclusion and governance. The responsibilities of managing technological solutions, economic benefits and politics thus lie with the region developing an IWCM per its specific needs.

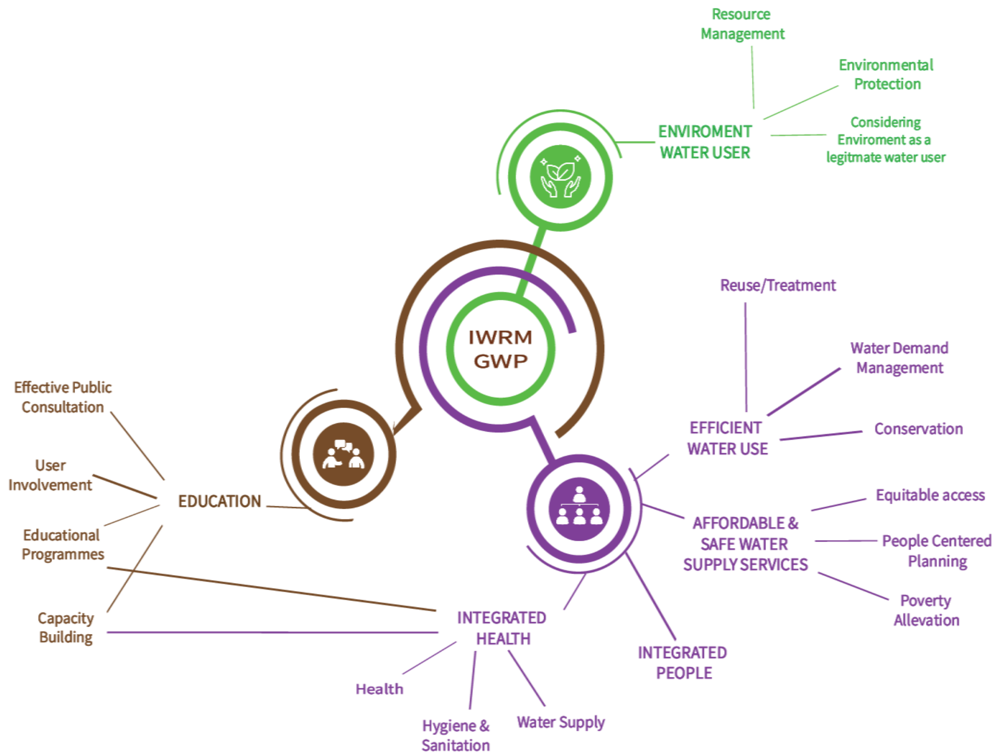

Figure 3. Integrated Water Resource Management–Global Water Partnership, International.

However, global IWCM projects are financed and managed by the World Bank for country-level and cross-boundary water management programs under the 'Global Environment Facility (GEF) Trust Funds' project. The World Bank Group is the largest single investor in water projects globally alongside GWP, supporting technical expertise with funding resources.

3.2. Water-Wise Cities, the International Water Association

Water-Wise Cities is the IWA framework of principles comprising four action levels to plan and design cities for resilience. Water-wise behaviours aiming to achieve the objective of maximising sustainable urban water outcomes are noted to be leadership culture, governance arrangements, professional capacity and innovative technology [48]. The 17 principles of Water-Wise Cities consist of 5 building blocks and 4 actions by which urban stakeholders can deliver sustainable urban water outcomes, becoming a water-wise community. Sustainable urban water management is defined in the Water-Wise Cities framework as follows: all water within the city (including reservoir and aquifer water, desalinated water, recycled water and stormwater) is managed in a way that recognises the connection between services, urban design and the basin. Its approach maximises achieving urban liveability outcomes and resilience to unexpected social, economic or bio-physical shocks while replenishing the environment. The 17 principles under the 4 actions are reconfigured in the STEEPI framework as shown in Figure 4.

Water-sensitive urban design is categorised as services and technology options, regenerative water services as environmental protection, basin-connected cities as governance measures and water-wise communities as social inclusion initiatives.

3.3. Holistic Water Management in the United States

Water management in the US is diverse and complex. Bringing it under a singular system of water management is an ongoing challenge. The One Water framework has been developed to manage water as a singular and holistic system. The One Water concept design was adapted from the IWRM-GWP concept, and it includes liveability (social) and drives economic and climate resilience. The TWM concept is a planning tool to develop robust water management plans. Section 3.3.1 describes One Water, and Section 3.3.2 describes TWM.

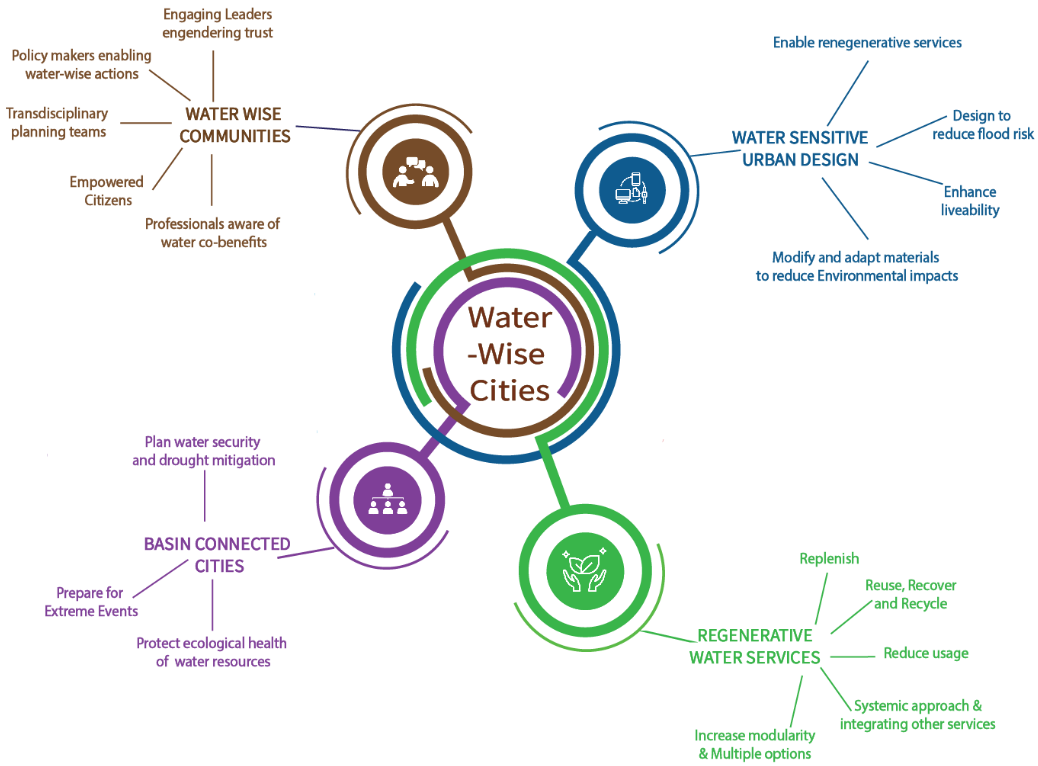

Figure 4. Water-wise framework by IWA re-aligned to STEEPI framework.

3.3.1. One Water in the United States

One Water advocates transitioning water management from a linear and disaggregated approach to an integrated, whole-of-water and social inclusion approach. Changing the approach requires moving to a productive, net-positive infrastructure where the aim is not just to 'do less harm' but also to create 'regenerative systems' that contribute to designing liveable cities; protect human health; provide flood protection; are resilient to changes in climatic conditions and economic fluctuations; provide a reliable, secure and clean water supply; minimise environmental pollution; and use and re-use natural resources efficiently [49].

The One Water concept fosters the development of the urban, social and environmental landscape. It strives for a greater coordination among diverse interests, stakeholders and decision makers, recognising that water quantity and quality (above and below ground) depend on multifaceted collaborations. It recognises that water is more than an area of service; it is a key component of liveable cities. One Water addresses five of the six STEEPI categories, as shown in Figure 5.

The One Water concept focuses on environmental issues related to water, such as pollution control, climate resilience, economic resilience, liveable cities, human health protection, the re-use of natural resources and water supply management. Safe, secure and access to clean water are addressed as sub-major components of water supply management, whereas social inclusion is captured through stakeholder collaboration and community engagement. Funding for the projects is captured under economic resilience.

3.3.2. Total Water Management—Integrated Water Resource Planning in the US

TWM is defined as strategies for utility master planning [50]. It is an approach that seeks a better management and efficiency of water resources and breaks down institutional barriers that separate water into silos of drinking, wastewater and stormwater [40]. It is referred to as adaptive plans that can formally address the risks and uncertainties of forecasting the water supply and demand needs [40] and as an implementation planning tool [50].

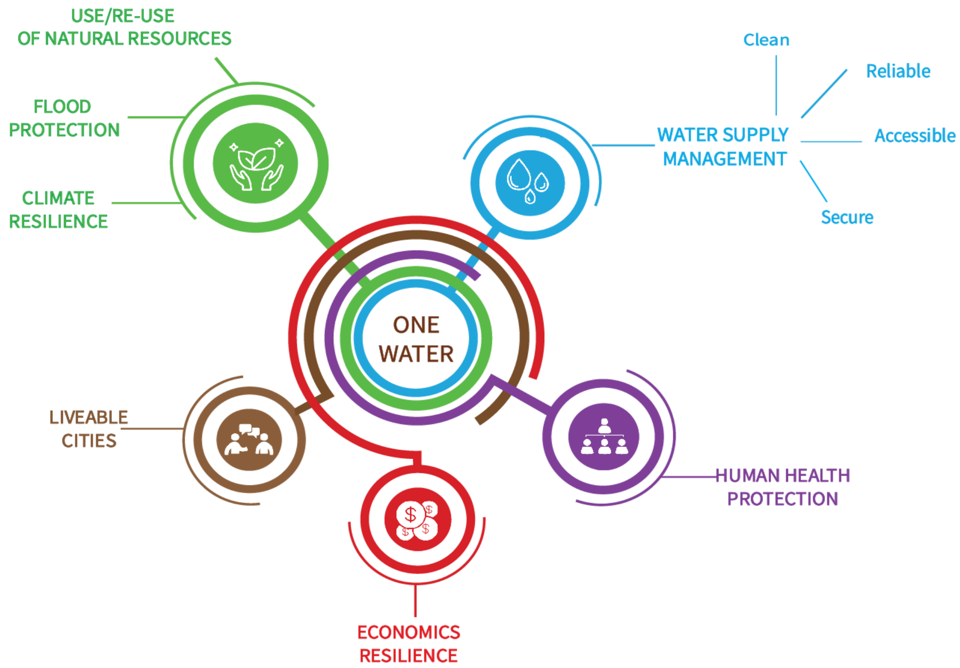

Figure 5. One Water—IWCM interpretation in the US.

TWM is analysed and interpreted via the STEEPI framework in Figure 6. The components of the water management planning criteria were allocated into the STEEPI categories, depending on the importance placed on the management area.

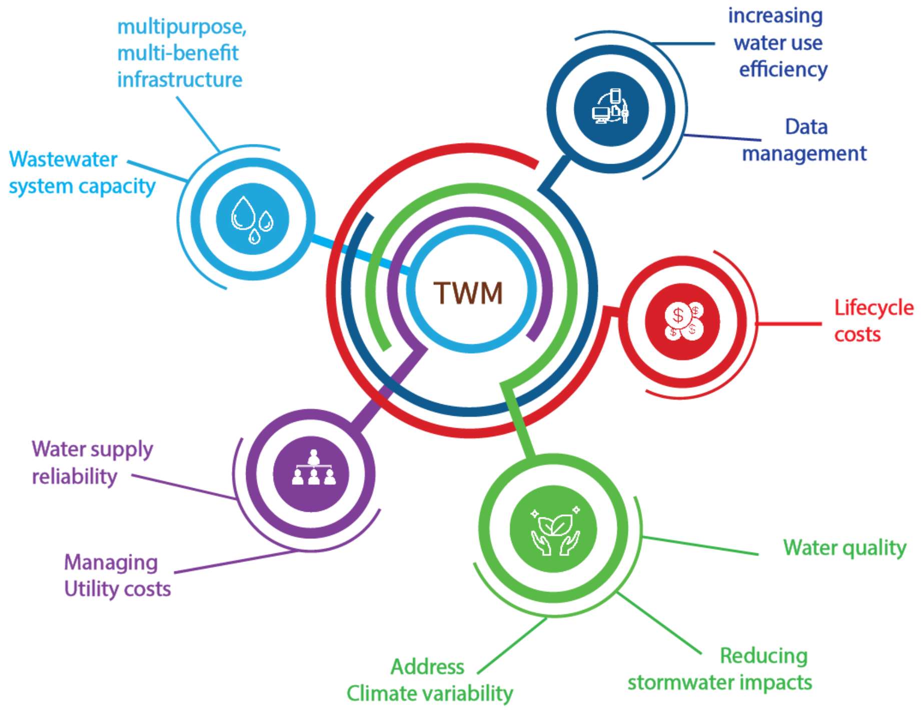

Figure 6. Total Water Management in the US.

TWM's goal is to develop multipurpose, multi-benefit strategies in order to address chronic droughts, ensure water supply reliability under all hydrologic events, improve drinking water quality, manage utility costs, provide a wastewater system capacity, reduce stormwater impacts and increase water-use efficiency. Furthermore, climate variability data, lifecycle costs and water quality are collected for continuous improvements and planning. Planning also includes increasing open space, reducing energy consumption, managing costs and improving the quality of life of citizens [40].

The TWM planning guidelines were developed following the principles of adaptive planning. The TWM planning tool is categorised in the Plan–Do–Check–Act framework as shown in Figure 7 below.

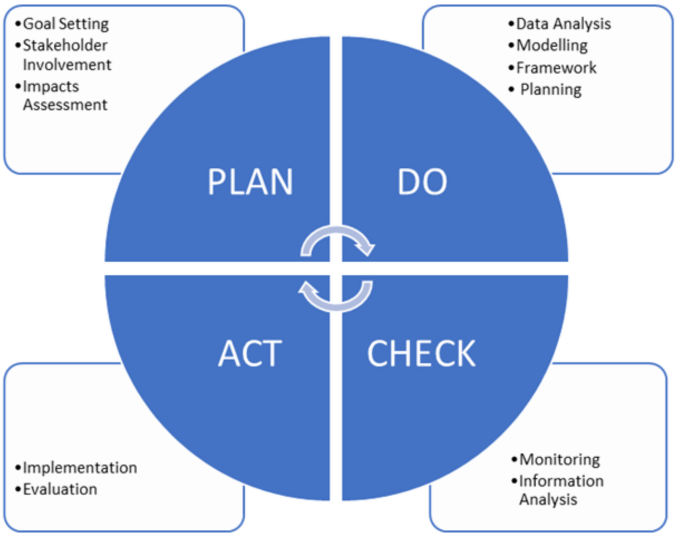

Figure 7. Total Water Management—the planning tool.

TWM is a planning process developed to enhance liveable city outcomes. It is a planning process used to examine urban water systems in a more interconnected manner, focusing on reducing water demands; increasing water recycling and re-use; creating water supply assets from stormwater management; matching water quality to end-use needs; and achieving environmental goals through multipurpose, multi-benefit infrastructures [47].

3.4. River Basin Management System in EU

In the EU, the first water legislation wave was rolled out from 1975 to 1988, introducing sustainability principles. A review of this legislation in 1991 identified gaps in practice and knowledge, triggering the second wave of water legislation 'reforms'. The improvements made little difference to the overall outcomes and necessitated a fundamental shift in water management thinking. Water policies in the EU were fragmented and needed a holistic approach—an 'integrated' approach. The stakeholder consultation process undertaken by the European Parliament's Environment Committee and Council of Environment Ministers resulted in a proposal for a 'Water Framework Directive'—an integrated river basin management system.

Water Framework Directive

The Water Framework Directive (WFD)—the EU interpretation of IWCM, adopted in 2000—is a single system of river basin water management, also referred to as integrated river basin management (IRBM). The WFD institutionalises river basin management for water protection and encourages a cross-sector integrated approach and stakeholder participation [51].

WFD was originally categorised into eight major basin-scale management components of a single system of water management: expanding the scope of water management; water-use cost savings; a combined approach; emission limit values; affordability addressed as the right pricing; consultation and citizen involvement; streamlining legislation; and achieving a 'good' state or best practice management outcomes. These eight categories were grouped into four of the six STEEPI categories. Technology and environment were assumed across the four defined categories. Figure 8 illustrates the WFD grouped in the four STEEPI categories of Water CI, governance, social inclusion and finance.

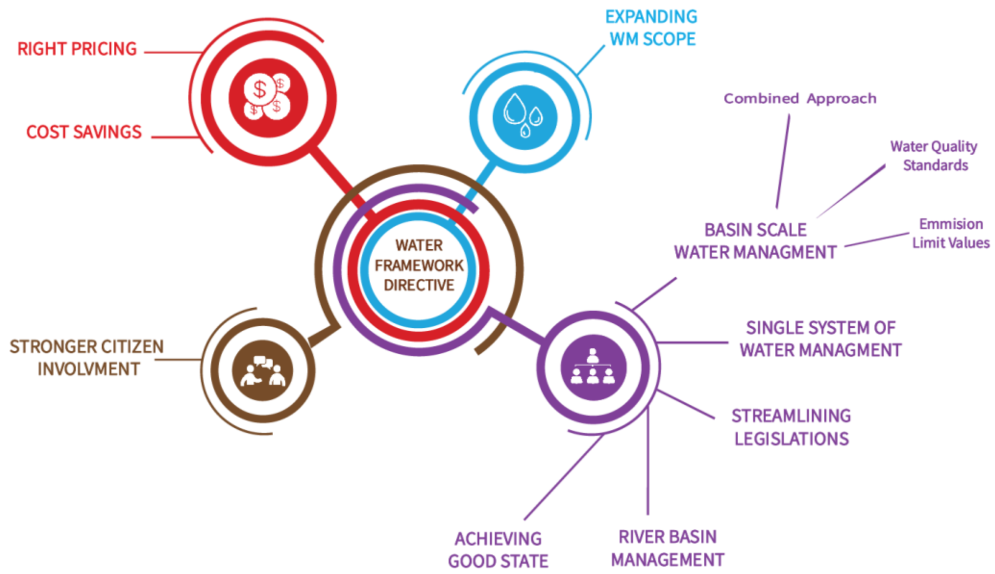

Figure 8. Water Framework Directive—river basin management in EU.

Here, finance is captured indirectly within affordability, the right pricing structure, cost savings and Water CI (asset management) planning to expand the scope of water management. There is little or no emphasis on technology and NRM measures and challenges [52].

The management plan (Figure 9) summarised by La¨nderarbeitsgemeinschaft Wasser (LAWA), a federal working group established to coordinate water-related issues and regulations and to implement the European directives, is cited by Evers [53] and notes an approach for identifying and coordinating synergies between WFD and the Flood Directive. The approach is based on adjusting the available options, proposed measures and potential results, as shown in Figure 8. The compilation of proposed measures was published to implement WFD's IRBM system [53].

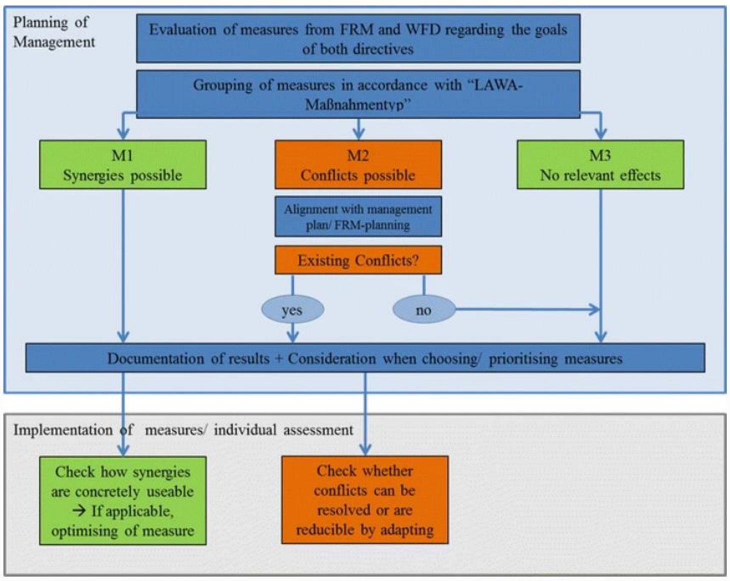

Figure 9. Management plan for IRBM (WFD-EU).

4. IWCM in Australia

In Australia, the interpretation, design and implementation of an IWCM concept vary substantially. Regulatory organisations and non-governmental approaches have different perspectives on what an IWCM concept should look like and have carried out detailed studies on identifying the scope of IWCM. The PC, WSAA, Victoria and NSW-DPIE are examples of initiating the design and implementation of IWCM in Australia and in the states of Victoria and NSW.

Five prominent IWCM interpretations have been designed to adapt to organisational goals. These IWCM interpretations are as follows:

(1) IWCM—PC—federal government organisation—national;
(2) IWCM—WSAA—non-government organisation—national;
(3) IWMF—Victoria, Australia—government authority—state;
(4) IWCM—NSW, Australia—government authority—state;
(5) UWCPG—Barwon Region, IWCM group—regional NSW.

All five Australian concepts emphasize stakeholder engagement and long-term planning but focus on different water management areas. The PC's main 2020 focus is the 'blue–green economy' (environmental) and 'least-cost option' (economics) of water management; WSAA-IWCM leans towards resilience and liveability outcomes—social aspects of water management; IWMF focuses on communications and governance measures; and IWCM, DPIE-NSW focuses on the governance structure. There is an assumption that the water management responsibilities pertain to councils in rural–regional areas and to local water utilities in the greater metropolitan regions of Australia. South Australia is the country's only state with a single agency to manage water supply and demand for the whole state. These five interpretations are discussed in Section 4.1. to Section 4.5.

4.1. IWCM: PC-2020—Productivity Commission, Australia

The Productivity Commission in Australia is a strong promoter of the IWCM concept in the context of water pricing and charges. In 2020, an independent report was commissioned to investigate the implementation of IWCM in Australia. In this report [54], IWCM is defined as a tool to achieve water security via addressing the key functions of urban water management: supplying fit-for-purpose water; wastewater management (appropriate disposal/treatment); stakeholder engagement and involvement; storm and flood water management; and the least-cost option for the provision of services for a blue–green economy.

The PC's emphasis is on community-based outcomes that include urban amenities, water supply, wastewater management and the consideration of stormwater management as an integral part of water management. Commissioner Doolan has raised the question of why a 'good idea' such as an IWCM concept is difficult to implement [55]. The Environment Commissioner for Greater Sydney, Rod Simpson, refers to IWCM as a key driver for urban water planning. The PC's IWCM concept per the six STEEPI categories focuses mainly on four of the six categories: Water CI, governance, social inclusion and finance (Figure 10).

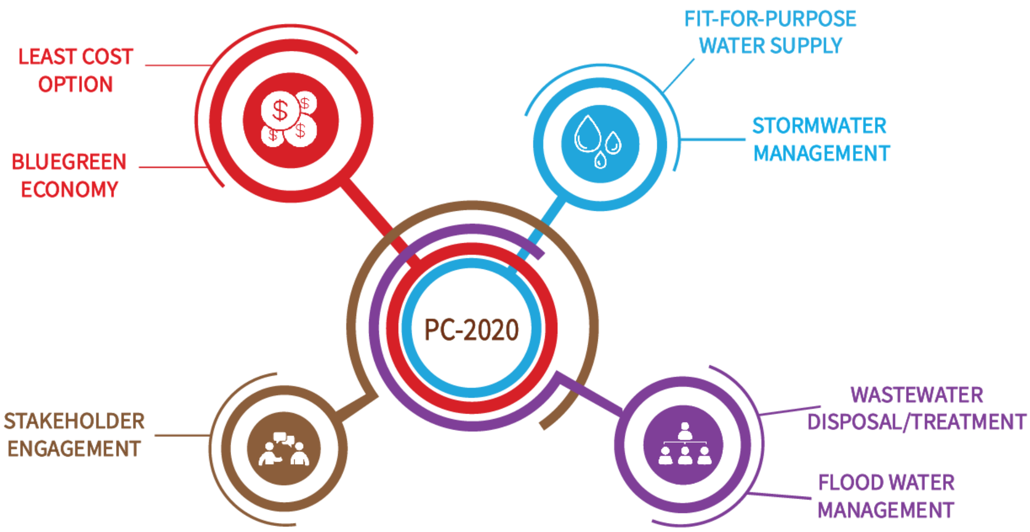

Figure 10. IWCM by PC, Australia.

Technology and natural resources management are assumed to be fundamental considerations of sustainable management practices and outcomes, without specific reference to their management. It is important to note that the organisational aims and objectives are to achieve a competitive pricing structure, which is well covered in the four STEEPI categories of IWCM.

4.2. WSAA-IWCM—Water Services Association Australia, Australia

WSAA is an industry body providing urban water services in Australia. The organisational context here concerns influencing, promoting, improving and fostering within and between urban water and sustainability in water services. The aims and objectives of WSAA are collaboration and support, which removes the need for the organisation to become involved in its member organisations' procurement and management of funds and infrastructure and technological needs. Resulting from this, WSAA recently published a document specifically defining the role of IWCM. It categorises IWCM into three major components: (1) management targeting sustainability outcomes, (2) planning targeting liveability outcomes and (3) stakeholder collaboration targeting resilience outcomes [4]. These categories are aligned with three of the six STEEPI categories: (1) NRM, (2) governance and (3) social inclusion, as presented in Figure 11.

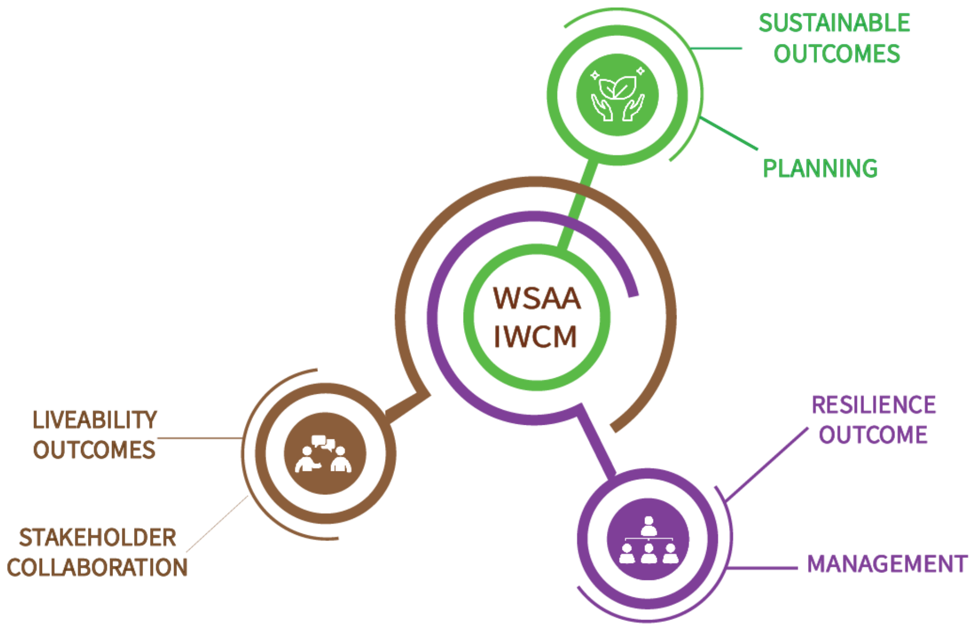

Figure 11. IWCM by WSAA, Australia.

According to this report, the 'foundational premise of IWCM is that the successful achievement of on-the-ground delivery outcomes is critically dependent on ensuring all the enabling outcomes are in place before the problem-solving phase commences'.

WSAA's two main proactive campaigns are as follows:

1. 'All options on the table' [56] is an action to enable environmental and infrastructure-related sustainability outcomes.
2. 'Transitioning of water management towards circular economy' [57] is an action towards delivering on-ground management outcomes.

All options on the table campaigns promote innovation and raise awareness about alternative solutions to a problem. The circular economy management systems are a step closer to closed-loop solutions and a move away from the current linear approaches to water supply–demand management systems.

WSAA's recent report by Skinner [4] summarises the best practice requirements for water utilities and recommends the following:

1. Embracing collaboration;
2. Focusing on customer and community;
3. Being outcome driven;
4. Having a system design that is owned by all stakeholders involved in the water cycle management;
5. Operating from planning to management;
6. Taking a whole-of-water cycle approach to planning, with all supply and demand options on the table;
7. Taking into account all options related to water, wastewater and drainage services;
8. Taking into account the environmental, cultural, social and economic dimensions of the area;
9. Closely integrating strategic and statutory land-use planning and water planning;
10. Supporting a circular economy by maximising efficiency and working towards regenerative outcomes;
11. Being fit-for-purpose—can be suited to different scales (e.g., catchment, region and precinct) and context (places and communities);
12. Being ambitious and transformative in striving for the broader outcomes of the sustainable development goals.

4.3. IWMF—Victoria, Australia

IWCM is referred to by the Department of Environment, Land, Water and Planning, Victoria (DELWP-Vic) as IWMF [58] for urban water planning and shared decision making throughout Victoria. IWMF has its roots in stakeholder engagement. The IWCM interpretation framework outlines how greater community value can be delivered by consistent and strategic collaboration within the water sector, including water corporations, local governments and catchment management authorities, and by links with organisations involved in land-use planning.

In Victoria, IWMF emphasises the importance of stakeholder awareness and governance. The IWM planning process details the structure and criteria for developing an IWM plan. Shared outcomes, integrated servicing options and cost allocations all refer to Water CI, with an overarching value proposition and collaboration.

The IWMF interpretation (see Figure 12) has six subcomponents and falls within the two main categories of the STEEPI framework: (1) social inclusion and (2) governance. The social aspect of the IWMF incorporates (a) communicating the value of IWM, (b) communicating the rationale for collaboration and (c) community values reflected in IWMF plans. The governance aspect of the IWMF incorporates (d) the contribution of IWM planning to water management activities, (e) IWM opportunities in plans and (f) consistency in the governance approach to provide support and guidance for collaborative planning [58–60].

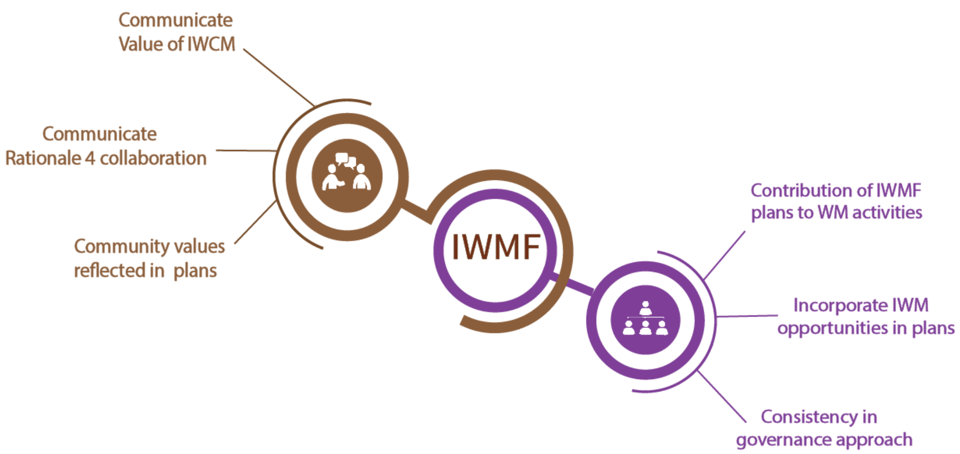

Figure 12. IWMF in Victoria, Australia.

Implementing IWMF requires stakeholders to commit, while accountabilities clearly define the roles and responsibilities of the organisation and collaborating organisations. Purpose-designed IWM forums have been formed in Victoria, 5 Metropolitan Melbourne Forums and 11 Regional Victoria Forums, with some overlap in boundaries towards the outer edge of the Metropolitan Melbourne boundaries (information extracted from the interactive Hydra Map). These forums are formed under the governance category of IWMF, consistent with a governance approach.

4.4. IWCM in NSW, Australia

The NSW Department of Planning and Environment defines IWCM as a long-term planning tool (30-year strategy) to identify and plan for an appropriately sized infrastructure. IWCM in NSW is rolled out as a policy and is funded by the Department of Planning and Environment (DPE). The funding requires IWCM plans to address all criteria in the checklist document. An extended version of the 'IWCM Strategy Checklist' updated in October 2019 provides exact details of what an IWCM strategy should comprise and why. The IWCM strategy development guidelines document was published to ensure that the strategies align with the NSW State Plan 2021 goals and objectives and that they are consistent state-wide and measurable [61].

The nine subtopics ensure that the necessary capital works are appropriately sized; the water infrastructure and services provided are appropriate, affordable and cost-effective urban water services that meet the water community needs and protect public health and the environment. The IWCM in NSW is represented in Figure 13, per the six STEEPI categories. The STEEPI categories addressed by IWCM in NSW are (1) social inclusion, (2) economy, (3) environment, (4) politics and (5) infrastructure.

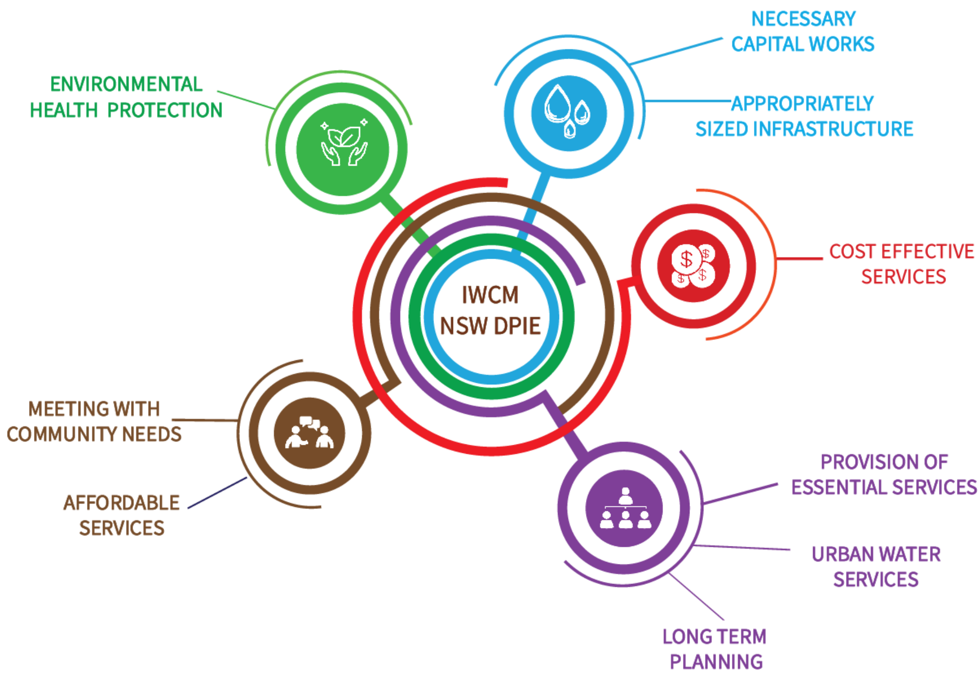

Figure 13. IWCM in New South Wales, Australia.

The NSW Office of Water (NOW) developed the IWCM's Best Practice Management (BPM) framework to ensure sound long-term planning, asset management, operation and maintenance; appropriate levels of service and community involvement; and the fair pricing of services, with strong pricing signals, full-cost recovery and affordable water and sewerage services, without wasteful 'gold plating' [62].

Further, each utility must closely involve its community in its implementation as required by the NSW BPM Framework: the IWCM Strategy and Financial Plan. A required outcome for each water supply and sewerage infrastructure is to have a strategic business plan, water conservation measures, a drought management plan and performance monitoring. Pricing outcomes must include full-cost recovery, appropriate residential charges, appropriate non-residential charges, a development servicing plan with commercial developer charges, strong pricing signals (with at least 75 percent of residential revenue from usage charges), an appropriate trade waste regulation policy and approvals and appropriate trade waste fees and charges. A particular emphasis is placed on consultation and stakeholder engagement throughout the IWCM policy-making process and implementation process.

4.5. Urban Water Cycle Planning Guide

The Urban Water Cycle Planning Guide (UWCPG), an online resource, was developed collaboratively by the Barwon Region IWCM group, funded by Water Research Australia and Water Smart Fund. The diagram in Figure 14 illustrates the influence of the legal frameworks that guide the development of water management planning. The guide provides direction to enhance liveability outcomes through the whole-of-water cycle management approach by considering water-sensitive urban design criteria.

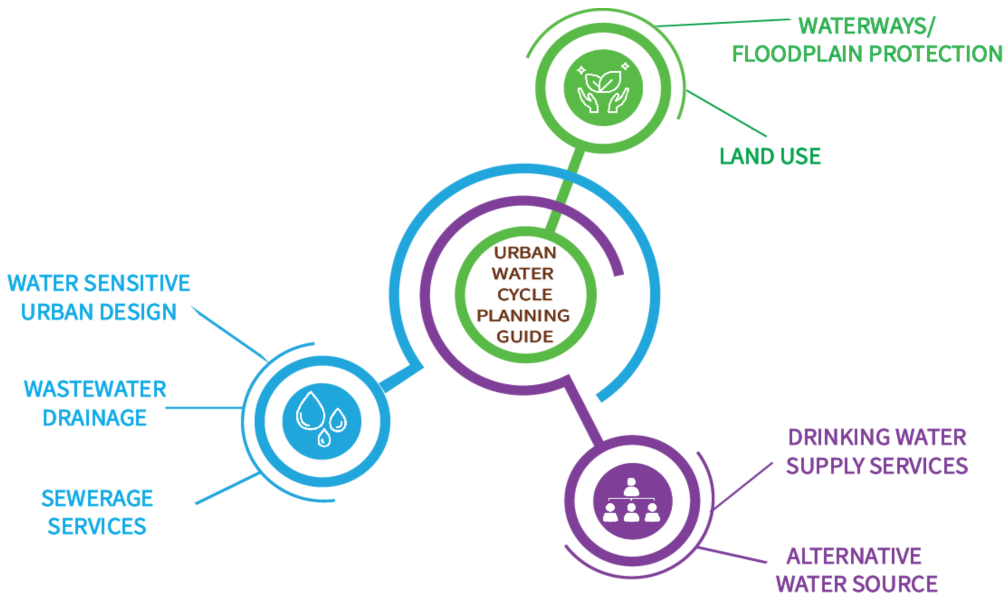

Figure 14. IWCM components in a UWCG process.

The UWCPG defines the IWCM strategy as developing the progressive conceptual model to detailed planning, where each aspect is considered in a specific sequence. The process also provides guidance on identifying factors influencing the planning process of IWCM policies, strategies, objectives, masterplan designs and delivery.

The UWCPG covers seven subcomponents of an IWCM plan, addressing waterways and floodplains; major drainage; land-use planning; water-sensitive urban design; drinking water supply servicing—LoS; sewerage services; and alternative (fit-for-purpose) water sources. These seven components are categorised in Figure 14 in three of the six STEEPI categories: (1) environment, (2) politics and (3) infrastructure. UWCPG particularly focuses on providing a higher LoS by managing the water supply–demand infrastructure due to changes in land-use planning and climate variations.

4.6. Comparative Analysis

This section compares the IWCM interpretations discussed above and looks through the STEEPI framework's lens. A comparison of IWCM interpretations in Table 1 reveals the importance of the six STEEPI categories adapted for IWCM practices to address local challenges.

Table 1. Comparison of IWCM interpretations in the STEEPI framework.

IWCM	IWRM-GWP	Waterwise Cities	One Water	TWM	WFD	PC	WSAA	IWCM	IWMF	UWCPG
S—Social Inclusion	√	√	√	√	√	√	√	√	√	
T—Technology		√		√						
E—Water Economics			√	√	√	√		√		
E—NRM	√	√	√	√			√	√		√
P—Governance	√	√	√	√	√	√	√	√	√	√
I—Water CI			√		√	√		√		√

Social inclusion is addressed by 9 of the 10 interpretations. Although social inclusion is not addressed directly in the UWCMG, forming partnerships and collaborating externally and internally within the organisation captures the essence of stakeholder engagement practices and inclusiveness. All nine interpretations capture social inclusion as stakeholder engagement or involvement. Additionally, IWRM includes capacity building, WSAA and One Water's pathway via the design of liveable cities. IWCM in NSW is concerned with meeting community needs and providing affordable services, and IWMF in Victoria entails communicating the values and rationale of an IWCM for greater adoption.

Technology has time and again proved to be a major disruptor and one that impacts all other categories. For example, it did not win a spot for itself as a major challenge until the drawn-out COVID-19 pandemic, forcing us to rethink how we work and address challenges. Exponential technological growth and our increasing dependence on technology are changing how we perceive the term 'technology'. Two of the ten IWCM interpretations consider technology challenges strong enough to merit their own category. They are Water-Wise Cities by IWA and TWM in the US. TWM addresses technology as data collection requirements to identify climate variability and climate change impacts. In contrast, the Water-Wise Cities framework examines technology from a WSUD perspective to address design challenges in order to enable regenerative services, enable liveability and modify and adapt materials to reduce environmental impacts. The Water-Wise Cities framework notes services and materials as technology and drives the much-needed shift of expanding the definition of technology.

Five of the ten IWCM interpretations note the economics of water management as a critical requirement of developing an IWCM interpretation. The IWRM interpretations by GWP and Water-Wise Cities focus on water governance measures, leaving water economics to regional IWCM interpretations, the World Bank and political leaders. The WSAA's focus on liveability leans towards the social and cultural aspects of water management. In contrast, IWMF drives water governance through stakeholder engagement and collaboration, leaving water economics out of the primary equation, but it is considered an expected outcome. UWCPG is a planning tool focused on delivering IWCM interpretations. Water economics is addressed by five IWCM interpretations as cost savings (WFD), achieving technological resilience (One Water), ensuring cost effectiveness throughout the lifecycle of the infrastructure (TWM), a blue–green economic system with the least-cost option (PC) and cost-effective service provision (IWCM in NSW). Water economics does not capture job creation as its integral part, but it primarily focuses on cost savings and cost effectiveness.

Environment (NRM) is addressed by seven of the ten IWCM interpretations. The WFD, PC and IWMF address NRM by following sustainability principles, but they do not specify or clarify where or how these principles are incorporated. Environment is an assumed overarching outcome or secondary outcome. For example, the core categories are addressed to manage an infrastructure project: asset management, finance and governance. Sustainable procurement is a desired outcome but not mandated. Each of the seven interpretations captures the protection of the environment as its component. Only IWRM promotes environment as a legitimate water user, whereas Water-Wise Cities, One Water and UWCPG note flood management/protection and environmental health as their core component. One Water and TWM, the IWCM interpretations in the US, are the only ones that capture climate resilience and address climate variability as their core components. Emissions from ongoing operations are not considered for Water CI.

Governance is acknowledged and addressed by all 10 IWCM interpretations as the most important management criterion, and it is considered vital to implementing an IWCM interpretation. Governance is predominantly used for planning, community engagement/involvement and education. The complex political influences on these components are discounted from the equation.

Water CI is addressed in 5 of the 10 IWCM interpretations, even though the importance of Water CI is significant. The IWRM, Water-Wise Cities, WSAA and IWMF concepts leave it to local and regional IWCM interpretations to identify infrastructure needs. TWM captures infrastructure needs as an inherent requirement to implement the first five categories of the STEEPI framework. One Water, WFD and PC capture Water CI as water supply and demand management infrastructure and related services. IWCM in NSW considers the size of an infrastructure as an essential part of infrastructure development, whereas UWCPG focuses on WSUD and wastewater services.

5. Conclusions

Water management is complex, and planning to ensure all water supply demands are met with a changing climate is even more complex. The challenges of water management are both global and local. Meeting the multifaceted challenges of water management has seen a range of IWCM frameworks developed on global, national, state and regional scales. Focusing on Australia as a starting point, this paper compares 10 IWCM interpretations regarding their organisational context, drivers of change, issues covered and response to challenges.

Each interpretation adapts the IWCM concept to address local or regional challenges to some extent; however, this occurs within the constraints of the organisations' roles and responsibilities. Implementing these IWCM frameworks also depends on the local water demand and supply requirements, resource availability and financial capabilities.

The comparative analysis of the 10 IWCM interpretations notes and discusses the similarities and differences adapted to the different regions. All IWCM interpretations are reviewed and compared through the lens of the STEEPI framework. The ten IWCM interpretations comprise two global interpretations, five national-scale interpretations, two state-level interpretations and one regional interpretation.

This review highlights that, for the two global interpretations, a strategic outlook is the primary focus while addressing governance issues, social inclusion and environmental challenges. The economics of water management is high on the agenda for the five national-scale interpretations, whereas NRM is considered to be of primary importance. The regional interpretation considers Water CI as one of three main criteria. None of the national, state or regional-level IWCM interpretations addresses technology in its independent category but refers to different aspects of technology, especially in governance and Water CI.

The five Australian interpretations discussed in this paper include two national-scale interpretations by WSAA and the PC, two state-level interpretations by NSW and Victoria and one regional interpretation by the Barwon Region's IWCM group. For the two national interpretations, WSAA focuses on water governance measures and knowledge sharing with its stakeholders. In contrast, the PC focuses on the least-cost option for Water CI and water economy to ensure the best LoS to communities. The two state-level interpretations are very diverse. The NSW interpretation is a holistic approach to IWCM and addresses each STEEPI category, except for technology. Conversely, the interpretation by the state of Victoria focuses on communities—inclusion, education and cost benefits of the different options help to make an informed decision.

It is interesting to note that, while the general understanding of an IWCM concept is that it primarily focuses on water critical infrastructure and technology, the findings of the comparative analysis paint a different picture. More precisely, our analyses instead indicate that all IWCM interpretations address governance and social inclusion as the most critical drivers for understanding and developing an IWCM interpretation.

Incorporating adaptive planning framework—the approach that focuses on both governance and social inclusion and a concept that allows for flexibility in planning for future water needs through collaboration and co-operation—is a potential solution for developing an implementable IWCM strategy.

Author Contributions: Conceptualisation of this literature review is an outcome of the master's in research project; methodology, validation, analysis, investigation, resources, and writing—original and final draft preparation, T.R.; review, guidance and editing, S.F. and P.M.; visualisation was carried out by T.R. All authors have read and agreed to the published version of the manuscript.

Funding: This is an independent PhD research program funded by the Institute of Sustainable Futures, University of Technology, Sydney. Funds are available for stakeholder engagement for research, conference attendance and professional development purposes only. No funds have been availed to support the publication of this paper.

Data Availability Statement: This is a desktop research study and does not involve any external stakeholder engagement. The information has been reviewed by my supervisors who are also co-authors of this paper. All interpretations provided in this paper either reference the original source or are the author's own analytical interpretation.

Acknowledgments: I would like to acknowledge Jason Prior, my research academic officer, for his ongoing support in reviewing the progress of my PhD program plan, the administrative team and IT team at ISF, UTS. I would also like to acknowledge the graphic designer, Niyati Shah, for converting the mud maps into readable graphics. Last but not least, I would like to thank my family and friends for their unequivocal support.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

References

1. World-Bank. *High and Dry: Climate change, Water, and the Economy*; World Bank: Washington, DC, USA, 2016.
2. Barry, M.E.; Coombes, P.J. Planning resilient water resources and communities: The need for a bottom-up systems approach. *Australas. J. Water Resour.* **2018**, *22*, 113–136. [CrossRef]
3. Baba, A.; Tayfur, G.; Gündüz, O.; Howard, K.W.; Friedel, M.J.; Chambel, A. *Climate Change and its Effects on Water Resources: Issues of National and Global Security*; Springer Science & Business Media: Berlin, Germany, 2011.
4. Skinner, R.; Satur, P. *Integrated Water Management: Principles and Best Practice for Water Utilities*; Summary paper, prepared for the Water Services Association of Australia by Monash Sustainable Development Institute; Monash University: Melbourne, Australia, 2020.
5. Mukheibir, P. Water access, water scarcity, and climate change. *Environ. Manag.* **2010**, *45*, 1027–1039. [CrossRef] [PubMed]
6. New South Wales Audit Office. *NSW Auditor General's Report: Support for Regional Town Water Infrastructure. Performance Audit Report*; Audit Office of NSW: Sydney, Australia, 2020.
7. Deshpande, A.; Miller-Petrie, M.K.; Lindstedt, P.A.; Baumann, M.M.; Johnson, K.B.; Blacker, B.F.; Reiner, R.C. Mapping geographical inequalities in access to drinking water and sanitation facilities in low-income and middle-income countries, 2000–2017. *Lancet Glob. Health* **2020**, *8*, e1162–e1185. [CrossRef]
8. The Lancet Global Health. Water and sanitation in a post-COVID world. *Lancet Glob. Health* **2020**, *8*, e1101. [CrossRef] [PubMed]
9. Baba, A.; Gunduz, O.; Friedel, M.J.; Tayfur, G.; Howard, K.W.F.; Chambel, A. NATO Science for Peace and Security Series—C: Environmental Security. In *Climate Change and its Effects on Water Resources Issues of National and Global Security*; Springer: Amsterdam, The Netherlands, 2010.
10. Artzy, M.; Hillel, D. A Defense of the Theory of Progressive Soil Salinization in Ancient Southern Mesopotamia. *Geoarchaeology* **1988**, *3*, 235–238. [CrossRef]
11. Lund, J. Approaches to Planning Water Resources. *J. Water Resour. Plann. Manag.* **2021**, *147*, 04021058. [CrossRef]
12. Tennessee Valley Authority. Annual Report FY2000ar. Tennessee Valley Authority. (n.d.). USA. 2000. Available online: http://www.tva.com/finance/reports/annualreport_00/index.htm (accessed on 28 March 2023).
13. Snellen, W.B.; Schrevel, A. IWRM, for sustainable use of water; 50 years of international experience with the concept of integrated water resources management; Background document to the FAO/Netherlands Conference on Water for Food and Ecosystems. Alterra, Alterra Report 1143. In Proceedings of the FAO/Netherlands Conference on Water for Food and Ecosystems, The Hague, The Netherlands, 31 January–5 February 2005.

14. Howe, C.; Cardone, R. Advancing OneWater in Texas Final. 2018. Available online: https://cgmf.org/graphics/cgmf_one_water_report_02_14_18_final.pdf (accessed on 19 March 2023).
15. Mayfield, C. *Introduction to IWRM, UNU-INWEH*; United Nations Water Virtual Learning Centre: Hamilton, ON, Canada, 2004.
16. United Nations. *Integrated River Basin Development—A Report by Panel of Experts*; United Nations Department of Economic and Social Affairs: New York, NY, USA, 1958.
17. Van der Gun, J. *Conjunctive Water Management—A Powerful Contribution to Achieving the Sustainable Development Goals*; UNESCO & Intergovernmental Hydrological Programme: Paris, France, 2020.
18. Colloff, M.J.; Pittock, J. Why we disagree about the Murray–Darling Basin Plan: Water reform, environmental knowledge and the science-policy decision context. *Australas. J. Water Resour.* **2019**, *23*, 88–98. [CrossRef]
19. Tantoh, H.B.; Simatele, D. Complexity and uncertainty in water resource governance in Northwest Cameroon: Reconnoitring the challenges and potential of community-based water resource management. *Land Use Policy* **2018**, *75*, 237–251. [CrossRef]
20. Law, I.B. An Australian perspective on DPR: Technologies, sustainability and community acceptance. *J. Water Reuse Desalination* **2016**, *6*, 355–361. [CrossRef]
21. Mankad, A.; Tapsuwan, S. Review of socio-economic drivers of community acceptance and adoption of decentralised water systems. *J. Environ. Manag.* **2011**, *92*, 380–391. [CrossRef]
22. Kanpurwala, T. Drivers and Challenges in Implementing an Integrated Water-Cycle Management Strategy in Regional NSW. 2020. Available online: http://hdl.handle.net/1959.14/1272873 (accessed on 5 February 2022).
23. Cai, X. Water stress, water transfer and social equity in Northern China—Implications for policy reforms. *J. Environ. Manag.* **2008**, *87*, 14–25. [CrossRef] [PubMed]
24. Benner, C.; Pastor, M. *Equity, Growth, and Community: What the Nation Can Learn from America's Metro Areas*; University of California Press: Oakland, CA, USA, 2015.
25. Thoradeniya, B.; Maheshwari, B. Strategies and Frameworks for Effective Stakeholders Engagement for Water Governance Leadership: A Review. *New Water Policy Pract.* **2018**, *4*, 19–55. [CrossRef]
26. Juma, C. *Innovation and Its Enemies Why People Resist New Technologies*; Oxford University Press: Oxford, UK, 2016.
27. Garrick, D.E.; Hanemann, M.; Hepburn, C. Rethinking the economics of water: An assessment. *Oxf. Rev. Econ. Policy* **2020**, *36*, 1–23. [CrossRef]
28. Chebly, J.E. The Value of Water: Economics of Water for a Sustainable Use. *Econ. Soc. Rev.* **2014**, *45*, 207–222.
29. Duda, A.; Menzies, S.; Severin, C.; Hume, A.; Sundstrom, K.R.; Zevgolis, D.; Zavadsky, I. *Contributing to Global Security—GEF action on Water, Environment and Sustainable Livelihoods*; Global Environment Facility—Investing in Our Planet: Washington, DC, USA, 2012.
30. Lake, P.S.; Bond, N.R. Australian futures: Freshwater ecosystems and human water usage. *Futures* **2007**, *39*, 288–305. [CrossRef]
31. Naddeo, V.; Balakrishnan, M.; Choo, K.-H. Frontiers in water-energy-nexus–nature-based solutions, advanced technologies and best practices for environmental sustainability. In Proceedings of the 2nd WaterEnergyNEXUS Conference, Advances in Science, Technology & Innovation, Salerno, Italy, 14–17 November 2018.
32. Tello, E.; Hazelton, J. The challenges and opportunities of implementing general purpose groundwater accounting in Australia. *Australas. J. Environ. Manag.* **2018**, *25*, 285–301. [CrossRef]
33. Fernandez, S. Much Ado About Minimum Flows ... Unpacking indicators to reveal water politics. *Geoforum* **2014**, *57*, 258–271. [CrossRef]
34. Swyngedouw, E. Social power and the urbanization of water: Flows of power. *J. Econ. Lit.* **2004**, *42*, 1246.
35. Raven, P. (Re)narrating the societal cyborg: A definition of infrastructure, an interrogation of integration. *People Place Policy Online* **2017**, *11*, 51–64. [CrossRef]
36. Greenberg, M.R. Delivering Fresh Water: Critical Infrastructure, Environmental Justice, and Flint, Michigan. *Am. J. Public Health* **2016**, *106*, 1358–1360. [CrossRef]
37. Birkett, D.M. Water critical infrastructure security and its dependencies. *J. Terror. Res.* **2017**, *8*, 1–21. [CrossRef]
38. Xue, X.; Schoen, M.E.; Ma, X.C.; Hawkins, T.R.; Ashbolt, N.J.; Cashdollar, J.; Garland, J. Critical insights for a sustainability framework to address integrated community water services: Technical metrics and approaches. *Water Res.* **2015**, *77*, 155–169. [CrossRef] [PubMed]
39. Pickering, J.; Davies, R.; Prizzon, A. Development co-operation: New perspectives from developing countries—Introduction for special issue of Development Policy Review. *Dev. Policy Rev.* **2017**, *35*, O1–O9. [CrossRef]
40. Rodrigo, D.; Calva, E.; Cannan, A. *Total Water Management—USEPA*; U.S. Environmental Protection Agency: Washington, DC, USA, 2012.
41. Bandaragoda, D.J.; Babel, M.S. Institutional development for IWRM: An international perspective. *Int. J. River Basin Manag.* **2010**, *8*, 215–224. [CrossRef]
42. NSW-DPI-Water. 2015-16 NSW Water Supply and Sewerage Performance Monitoring Report. 2017. Available online: https://www.industry.nsw.gov.au/__data/assets/pdf_file/0020/147440/2015-16-nsw-water-supply-and-sewerage-performance-monitoring-report.pdf (accessed on 19 March 2023).
43. GWP-TAC. *Global Water Partnership Technical Advisory Committe—Background Paper no. 04—Integrated Water Resources Management*; Global Water Partnership: Stockholm, Sweden, 2000.

44. Kenabatho, P.K.; Montshiwa, M. IWRM as a tool for drought planning and management in Botswana—A diagnostic approach. *Int. J. Sustain. Dev. Plan.* **2006**, *1*, 61–75. [CrossRef]
45. Mukheibir, P. *Small Towns Water Access and Climate Change—Towards Sustainable Access to Urban Water Services under Projected Climate Change Impacts*; LAP LAMBERT Academic Publishing: Saarbruecken, Germany, 2007.
46. Hirji, R.; Davis, R. *Strategic Environmental Assessment Improving Water Resources Governance and Decision Making—Main Report*; Water Sector Board Discussion Paper Series—Paper No. 12; The World Bank: Washington, DC, USA, 2009; Available online: http://www.worldbank.org/water (accessed on 15 May 2022).
47. Dinar, A.; Saleth, R.M. *Institutional Economics of Water A Cross-Country Analysis of Institutions and Performance*, 16th ed.; Institutional Economics of Water, World Bank Publications: Washington, DC, USA, 2004.
48. Wang, X.; Fu, G. *Water-Wise Cities and Sustainable Water Systems: Concepts, Technologies, and Applications*; IWA Publishing: London, UK, 2021. [CrossRef]
49. Howe, C.; Mukheibir, P. *Pathways to One Water. A guide for Institutional Innovation*; Water Environment Research Foundation: Alexandria, VA, USA, 2015. [CrossRef]
50. Jeffcoat, S.; Baughman, D.; Thomas, P.M. *Total Water Management Strategies for Utilities Master Planning*; American Water Works Association: Denver, CO, USA, 2009; p. 57.
51. Beveridge, R.; Monsees, J. Bridging parallel discourses of Integrated Water Resources Management (IWRM): Institutional and political challenges in developing and developed countries. *Water Int.* **2012**, *37*, 727–743. [CrossRef]
52. Marks, G. Structural Policy and Multilevel Governance in Europeon Communities. The Single Market. 1993, pp. 391–409. Available online: https://garymarks.web.unc.edu/wp-content/uploads/sites/13018/2016/09/marks-Structural-Policy-and-Multilevel-Governance.pdf (accessed on 19 March 2023).
53. Evers, M. Integrative river basin management: Challenges and methodologies within the German planning system. *Environ. Earth Sci.* **2016**, *75*, 1085. [CrossRef]
54. Productivity Commission. Integrated Urban Water Management—Why a Good Idea Seems Hard to Implement? Productivity Commission Review. 2020. Available online: https://www.pc.gov.au/research/completed/water-cycle#panel (accessed on 12 April 2021).
55. Productivity Commission. Water Cycle Webinar PC—Greening out Cities. 10 August 2020. Available online: https://www.pc.gov.au/research/completed/water-cycle/water-cycle-webinar.pdf (accessed on 12 April 2021).
56. Water Services Association of Australia. *Urban Water Supply Options for Australia—All Options on Table*; Water Services Association of Australia: Melbourne, Australia, 2020.
57. Jazbec, M.; Mukheibir, P.; Turner, A. *Transitioning the Water Industry with the Circular Economy*; Final 12102020; Water Services Association of Australia, Institute of Sustainable Futures, University of Technology Sydney: Sydney, Australia, 2020.
58. DELWP-Vic (2017), DELWP-IWM-Framework-FINAL-FOR-WEB. 2017; Web Publication by Department of Energy, Environment and Climate Action. Available online: https://www.water.vic.gov.au/liveable/integrated-water-management-program (accessed on 19 March 2023).
59. Victorian Planning Authority. PSP Guidelines Notes—Integrated Water Management (VIC). 2013. Available online: https://vpa.vic.gov.au/wp-content/Assets/Files/PSP_Guidelines_Notes_Integrated_Water_Management%5B1%5D.pdf (accessed on 11 November 2021).
60. Water Services Association of Australia. WSAA: IWM Case Study 2—Victorian IWM Framework. Available online: https://www.wsaa.asn.au/publication/iwm-case-study-2-victorian-iwm-framework (accessed on 19 March 2023).
61. Samra, S.; McLean, C. *Best Practice Management of Water Supply and Sewerage Guidelines*; Department of Water and Energy: Orange, Australia, 2007.
62. NOW. NSW—Best Practice Management for Water Supply and Sewerage Framework Summary—Flowchart. 2007. Available online: https://www.industry.nsw.gov.au/__data/assets/pdf_file/0009/146997/BPMF.pdf (accessed on 19 March 2023).