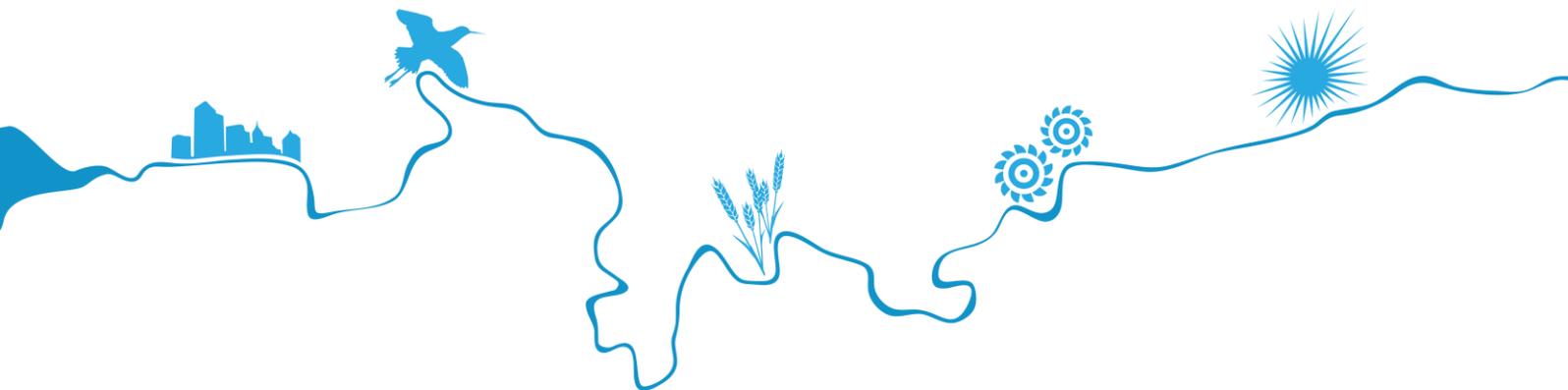


Future urban water management options for a vibrant and resilient Adelaide

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Respect and reconciliation

Aboriginal people are the First Peoples and Nations of South Australia. The Goyder Institute for Water Research acknowledges the range of First Nations' rights, interests and obligations and the cultural connections that exist between different First Nations and seeks to support their equitable engagement.

Aboriginal peoples' spiritual, social, cultural and economic practices come from their lands and waters, and they continue to maintain their cultural heritage, economies, languages and laws which are of ongoing importance.

We would like to acknowledge the traditional owners and custodians of Kurna country and associated lands and waters, both present and past.

Executive summary

Introduction

Healthy vegetation, waterways and coastlines underpin the social and economic wellbeing of urban communities. Yet, many of Adelaide's urban waterways are in a poor condition. Many were modified into concrete drains that support few community values and export stormwater with fine sediments (and other contaminants) to Adelaide's coast, which has contributed to the degradation of coastal seagrass communities. Indeed, while stormwater conveyance and flood mitigation have long been the primary aims of urban drainage infrastructure, even these functions are compromised by aging infrastructure, climate change impacts, urbanisation patterns (sprawl and infill), the absence of sustainable funding streams and an increasing diversity of community values around local waterways. While there has been some success in implementing stormwater harvesting in Adelaide to reduce runoff volumes to support urban greening, the total harvest is estimated to represent just 4% of Adelaide's annual storm runoff volume.

Across Adelaide, attention and action towards improving urban drainage and the health of waterways has increased. The value of vegetation, waterways, tree canopy, blue and green infrastructure in the public and private realm are known to improve liveability, mitigate climate change, support biodiversity and develop healthy neighbourhoods, and are recognised and promoted in the current *30 Year Plan for Greater Adelaide*. Nevertheless, there remains an opportunity to support the liveability of Adelaide by improving drainage, waterways, stormwater quality and coastal health and to provide water resources which can support urban vegetation and associated cooling. Realising this opportunity will require world leading governance, policy, funding and management arrangements.

The objective of this independent research panel project was to assess options for the future management of urban water and urban waterways to support a vibrant Adelaide. This was delivered through two tasks identifying:

- Options for future urban water and urban waterway governance, funding and policy arrangements for Adelaide based on a review of the effectiveness of national and international models.
- Integrated, on-ground management options for hydrological and ecological restoration to support healthy waterways, urban vegetation and associated urban cooling, and coastal environments.

The project was undertaken by forming two panels of experts, both researchers and practitioners, drawn from local and state government entities, universities and water industry bodies. One panel was established to focus on governance, funding and policy, while the other examined on-ground management options. Early in the process, each panel agreed that stormwater management would be a key focus, because the management of potable and wastewater in South Australia (SA) currently has greater consistency in terms of successful on ground management, greater clarity of responsibility and sustainability of funding. The project also focussed largely on water management in metropolitan Adelaide which represents the largest, most populated urban centre in South Australia.

Recommendations

The following recommendations were developed by the independent research panels in the areas of governance, policy, funding and on-ground actions. Suggested initial steps are also provided as useful starting points to action recommendations, noting that these initial steps could change as more information becomes available.

Governance

- 1. Transition to integrated urban water management arrangements for achieving economic, cultural, environmental and social outcomes for Adelaide, considering the benefits, costs and risks of alternative models.**

Rationale: The current model of urban water management has seen success but there are opportunities to clarify responsibility and improve financial sustainability for stormwater management. The panel agreed that the current arrangements for stormwater management are not clearly defined, with several local and state government entities having an interest but not necessarily an obligation by legislation to manage stormwater. This lack of clarity in responsibility inhibits the ability of government and industry to adopt the changes required to better support urban drainage, flood control, improved stream and coastal environmental quality and go the next step toward applying stormwater for greening and liveability. It was recommended that responsibility be clarified and a new governance model implemented with financial sustainability.

Suggested initial step(s): Following the completion of Strategy D.1 and D.2 of the SA Government *Urban Water Directions Statement* (the currently active 'Minister's stormwater expert panel' including management expertise which has been established to determine clear responsibility for private local, public local and regional drainage), pursue a formal cost benefit analysis and risk assessment of the recommended options. The independent research panel developed and discussed the potential benefits and costs of five options for alternative stormwater management that have potential to clarify responsibility and produce a funding model that is reflective of the true value of stormwater management. These included:

1. Incorporating management of urban water, including stormwater, into an existing utility – for Adelaide, the most reasonable outcome of this would be creating a SA Water in house business focussing on 'waterways'
2. Modifying the current system by incorporating governance of urban stormwater into Landscape Boards – in the case of Adelaide, for example, management responsibility would reside with Green Adelaide
3. Modifying the current system of stormwater governance by establishing regional entities drawn from local government – adopting a 'Regional subsidiary' approach to manage at catchment scale
4. Modifying the current system of stormwater governance by expanding the role of the Stormwater Management Authority such that it takes a larger role in governance
5. Developing a separate entity by establishing a separate utility for managing stormwater runoff and recycled stormwater.

The panel recommended that each option be properly assessed against agreed criteria, including assessment of all economic costs and benefits, feasibility of funding options, the level of change required and the potential for unintended consequences or other risks if implemented across the state. The potential to undertake a trial on a smaller catchment area was strongly supported and could involve implementing the alternative arrangements within a catchment area in Metropolitan Adelaide and/or a regional catchment.

2. Update the *Water Industry Act 2012* and other legislation to enable new governance arrangements to manage stormwater for flood control and as integrated water resources for achieving economic, cultural, environmental and social outcomes.

Rationale: At present, the responsibility for stormwater is not defined clearly in state legislation. Changes are required to the *Water Industry Act* (2012) and other related Acts and regulations to formalise the current arrangements, or to enable the implementation of alternative management options like those in Recommendation 1. The actual changes will depend on the approach selected. A key requirement is that stormwater should be considered within the definition of the 'water industry' as part of any adopted change. The Act should also be updated to ensure that the economic regulation of investments into improved stormwater management by government or partnership arrangement is efficient across water sources and water suppliers, such that the optimum value and integrated outcomes are achieved from on-ground measures. This recommendation was developed independently of, but in full agreement with, Recommendation 6 of the recent review of the *Water Industry Act* (2012).

Suggested initial step(s): As part of the review of Recommendation 1, identify the components of Acts and legislation that need to change, and where secondary impacts may occur when formalising/clarifying any current arrangements, or changes to how stormwater is managed.

Funding

- 3. Undertake detailed assessment of the socio-economic value of improved stormwater management in the current context; implement a targeted communication and engagement program to ensure this value is clearly defined and appreciated throughout the community; and identify and assess sustainable funding options to achieve improvements in stormwater management.**

Rationale: The current 'spend' on urban stormwater by local government, state government and other public entities is not clearly quantified, nor are works currently identified in stormwater management plans and asset replacement programs adequately funded. There is a need to identify sustainable funding options to achieve improved stormwater management including drainage, flood mitigation, harvesting and associated measures including greening and ecosystem restoration. These could include a dedicated levy for urban water management, development of offset arrangements based on onsite measures, or a dedicated component of the state budget. Such measures are unlikely to be supported by the community without identifying the current and required spend in detail and the associated savings or service improvements in other areas (such as savings in council rates or the existing Landscape levy that currently contribute significant funding to stormwater management). Identifying key areas of expenditure will also enable an assessment of where public/private partnership or other forms of entrepreneurship can be undertaken to improve the efficiency of stormwater drainage measures, waterway and coastal health improvement and seize opportunities for greening and liveability. Explicit costing is also required for evaluating the funding needs for different stakeholders when considering alternative options of Recommendation 1.

Suggested initial step(s): Seek to identify the current cost of stormwater management by all responsible parties (including local government, state government and developers) and ensure it is reported explicitly (rather than lumped with other measures); this may require resourcing to determine costs and adjustment of current cost reporting to make stormwater more explicit. This cost should be clearly described such that the benefits of adopting changes to management and funding are clearly understood in the community and sufficient funding measures developed with an understanding of the real (full) cost.

- 4. Ensure that the true value of stormwater management is realised and that all new developments have appropriate regard for its value.**

Rationale: The independent panel noted that measures for implementing stormwater runoff volume, flow rate reduction or runoff water quality improvement in new developments are not clearly defined in the current state planning and design code. While the code has some tree canopy protection and rainwater harvesting measures, there is an opportunity to implement better outcomes that benefit the developer and the community. One approach identified is to establish a means to enable the development industry to contribute to a fund or scheme to externalise onsite requirements. This could benefit a developer onsite by allowing for greater on-site development density whilst contributing to a fund for water or vegetation management at a priority location nearby (e.g. funding for urban drainage upgrades and maintenance works, greening measures, restoring a degraded stream section, or implementing an 'end of pipe' stormwater quality improvement measure). Drainage or water sensitive urban design projects already recommended by stormwater management plans are suggested to be considered as priority projects, or perhaps other measures developed under Recommendation 5 of this report. This also represents an opportunity for public/private partnership to improve flood control, greening, liveability and wellbeing. The independent panel also discussed the critical need to inhibit ongoing damage to streams via the planning approval process, specifically the cumulative impact of obstructions, infilling and encroachment of structures into riparian zones and drainage lines which represent a major barrier to delivering waterway health outcomes.

Suggested initial step(s): Targets for stormwater runoff volume, flow rate and water quality exist but have not been included throughout the current planning and design code in a consistent way by means of 'deemed to satisfy' provisions; consider including these targets in the planning and design code and investigate a means to establish... an 'offset' arrangement (administered by state or local government) which may be coupled with these more specific targets. If adopting offsets, there is a need to prioritise sites where larger scale stormwater runoff storage, improvement, reuse or ecosystem restoration may be implemented to achieve outcomes at catchment scale.

On-ground actions

5. Implement 'smart' integrated 'blue-green' catchment management plans for retaining water in the landscape, preventing and delaying inputs of stormwater into receiving waters and improving their condition.

Rationale: Ongoing development, particularly infill, increases urban population density and the volume and flow rate of runoff to receiving waters, and reduces green space and urban canopy on private land. This recommendation links with Recommendation 4, and recommends planning for improved water resource management, particularly stormwater, to improve wellbeing, liveability and biodiversity. While stormwater management plans developed by local government already exist to manage flooding, runoff volume and quality in a catchment, there is a need for planning to adopt greening, increased canopy cover targets using appropriate species and liveability measures. Spatially explicit regional planning could include prioritising where targeted stormwater interception, detention or infiltration measures could be located to efficiently improve streamflow regimes to downstream ecosystems and consider opportunities to harvest water to support developing and maintaining canopy cover or other green space. It should also prioritise where opportunities exist for protecting and restoring existing urban streams, for example, by converting existing drains to more natural systems and allowing the community to access these new blue/green spaces. The production of these blue-green plans should be based on input from both technical and social investigations, including seeking guidance from indigenous perspectives.

Suggested initial step(s): Identify and pilot a blue-green 'liveability improvement plan' for a demonstration suburb/subcatchment, identifying and prioritising opportunities for improved water management to occur that is coupled with opportunities for greening (supported where necessary by water harvesting) and ecosystem restoration of stream or drainage sites where access is possible. This should be supported with monitoring and evaluation to ensure that the longer-term benefits are achieved (see Recommendation 7).

6. Establish a connected and integrated harvesting and reuse scheme across Adelaide.

Rationale: At present there are several recycled stormwater schemes fed with stormwater or treated wastewater operating in metropolitan Adelaide. It is known that the current water recycling schemes are capable of collecting and delivering greater volumes of harvested runoff to users but this is impeded by the high cost of distribution pipelines to access new customers. This may be addressed by linking up currently separate 'third pipe' distribution and aging potable water infrastructure (while addressing all cross-connection risks) for the mutual benefit of scheme operators and the community. Linking schemes was suggested to improve the resilience of supply and provide a mains distribution that can be accessed by currently inaccessible points of demand, like industrial users and public open space. The potential for linking existing schemes to make the most of existing investment in alternative water infrastructure has been proposed only at the conceptual level and would need to meet a range of criteria, including economic merit. However, it was considered a high priority activity by the panel particularly while other infrastructure – such as transport corridors – are under design and construction which may enable the evolution of pipeline networks to occur more efficiently.

Suggested initial step(s): A conceptual assessment of what level of linkage between water supply authorities (e.g. SA Water, Salisbury Water and/or other local councils and private water harvesting and reuse systems)

is both economically and institutionally beneficial, with consideration of large-scale transport corridor upgrades where construction costs can be leveraged.

- 7. Establish a research, monitoring and performance evaluation program to identify the on-ground actions required to increase urban greening/vegetation and limit the export of runoff and fine sediments to Adelaide's coastline, including investigation of the land use sources of fine sediments and the effectiveness of different treatment options being applied.**

Rationale: A key driver for improved stormwater management is improving the quality of streams and coastal waters. It is well established that fine sediment and nutrients are the main causes of coastal water quality and seagrass decline. However, the key sources of fine sediment and nutrients are currently not well defined. There is little data available locally linking runoff water quality to land uses. Data on the extent of stream bank and channel degradation and how it contributes to fine sediment loads is limited. Data is also limited regarding the ability of common measures to improve urban runoff quantity and quality (e.g. bioretention, or street sweeping) or measures to restore stream bank and channel systems (such as armouring or runoff detention). Related to this, there is limited data about the performance of catchment greening approaches, such as what vegetation is most effective and/or most acceptable to the public, and where, or how common vegetation options perform when coupled with opportunistic stormwater infiltration measures. These are critical knowledge gaps that inhibit confidence in the effectiveness of investments into stormwater management and without improved understanding of critical sediment point sources and effective treatment options, will likely lead to ill-targeted investment and outcomes.

Suggested initial step(s): Establish a research program that addresses urban water management knowledge needs in the urban water space with a strong emphasis on monitoring runoff quality from key land uses contributing to local streams, and the rate of degradation in local streams. This could begin with mapping locations of high risk based on topography, soil type, flow rates and rainfall intensity. In conjunction, there is a need for evaluating the performance of commonly applied water quality improvement measures (such as bioretention and street sweeping regimes) and measures for protecting stream banks and channels. It is also important to evaluate the success of passive harvest and irrigation measures, such as infiltration systems and quantify the extent of their beneficial (or otherwise) relationship with vegetation, and the contribution of vegetation to the ecosystem.

- 8. Establish a robust monitoring and compliance program in new and existing developments, with a particular focus on identifying water quality impacts on receiving waters.**

Rationale: The independent panel perceived that the amount of active catchment surveillance has reduced over time, and there is limited ability for authorities, such as local government and the SA Environment Protection Authority, to evaluate the effectiveness of water quality improvement measures. A key focus of this was examining sediment controls at development sites across metropolitan Adelaide and undertaking work with the construction industry to improve it. Other measures of concern included those noted with Recommendation 4, where the cumulative impact of obstructions, filling and encroachment of structures into riparian zones of urban streams and drainage lines creates a major barrier to waterway health outcomes.

Suggested initial step(s): Re-establish active surveillance via public or environmental health officers targeting water quality improvement measures, including small- and large-scale development sites where on-site environmental management does not already include monitoring and reporting of runoff. It was recommended that this process begin as a learning partnership with industry to educate and improve practice, rather than a means to immediately 'punish' poor practice.

Acknowledgments

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The authors would also like to thank Rachel Barratt from Jacobs for facilitating the independent panel workshop sessions, and input from observers to the independent panel including Bruce Naumann from Salisbury Water, and Kane Aldridge and Daniel Pierce from the Goyder Institute for Water Research.

List of Acronyms

ACRONYM	MEANING
CDOM	Coloured Dissolved Organic Matter
DEW	Department for Environment and Water (South Australia)
EPA SA	Environment Protection Authority (South Australia)
GFP independent panel	An independent panel of research experts formed in this study to investigate options for future urban water and waterway governance, funding and policy arrangements
MAR	Managed aquifer recharge
OG independent panel	An independent panel of research experts formed in this study to investigate options for integrated on-ground management of urban water
SMA	Stormwater Management Authority
SMP	Stormwater Management Plan
SPP	State Planning Policy
WSUD	Water Sensitive Urban Design

1 Introduction

Healthy vegetation, waterways and coastlines underpin the social and economic wellbeing of urban communities. A 2016 survey of South Australians and their environment identified that people in South Australia (SA) strongly value, and frequently engage with their natural environment (Government of SA, 2016). Yet, during the COVID-19 pandemic, residents of Adelaide visited the fewest number of different green or blue spaces and spent the least amount of time in green/blue spaces compared to other Australian major cities (Astell-Burt and Feng, 2021).

There are several potential barriers that may be impeding the capacity to manage and adapt urban waterways and stormwater to support community values. These may include complex legislation, gaps in governance and funding arrangements; competing interests associated with urban development; and 'flashy' hydrological regimes, with limited space for water storage and treatment.

Innovative and integrated water management arrangements and practices that improve the health of urban waterways, coastal environments and urban landscapes will be critical for supporting the vibrancy of Adelaide into the future. Indeed, there is a strong desire across all government agencies with a role in waterway and urban water management to maintain and enhance the 'vibrancy' and resilience of Adelaide. This includes 'greening' initiatives to produce both an ecologically vibrant urban environment, as well as to provide associated cooling of the urban environment for ensuring climate resilience. In addition to greening, the management of water is also crucial to ensure the preservation of existing natural waterways, restoration of channelised waterways and ultimately the protection of coastal seagrass communities. There is also a need to consider and incorporate Indigenous perspectives into integrated water management (Frangos et al., 2020).

1.1 Objectives

The objective of this project was to assess options for future management arrangements of urban water and waterways to support a vibrant Adelaide. This was delivered through an independent panel of experts consisting of leading researchers and practitioners within an interdisciplinary project team (henceforth called the independent panel). Whilst this involved a review of appropriate literature, the intent of the project was not to undertake a detailed literature review but to instead capture the collective knowledge of the panel related to the objective. This involved two main tasks with discrete but related objectives of identifying:

- options for future urban water and urban waterway governance, funding and policy arrangements for Adelaide based on a review of the effectiveness of national and international models.
- integrated on-ground management options for alternative water sources to support healthy waterways, urban vegetation and associated urban cooling, and coastal environments.

During the project planning phase, it was determined that each objective above would be addressed by two separate panels of research experts. Preliminary key questions developed to guide the discussion for each panel were developed and provided below.

Key questions related to stormwater and urban waterway governance, funding and policy arrangements for Adelaide

- What are the strengths, weaknesses, opportunities and threats of current waterway and recycled urban water management governance, funding and policy arrangements in Adelaide and from across Australia and the world?
- What are possible future models for stormwater/drainage and urban waterway governance, funding and policy arrangements for Adelaide?
- What are the key knowledge gaps that will impede future effective management of urban waterways, stormwater, water supplies for vegetation canopy cover and coastal environments?

Key questions related to integrated on-ground management options for stormwater

- What surface water and groundwater storage, treatment and transport options exist to support healthy waterways, urban vegetation and associated urban cooling, and coastal environments?
- What opportunities exist for integration of surface water, recycled wastewater and groundwater storage, treatment and transport options to support healthy waterways, urban vegetation and associated urban cooling, and coastal environments?
- What are the key knowledge gaps that will impede future effective management of urban waterways, recycled wastewater, stormwater, vegetation and coastal environments?

The output of the project was intended for consideration by stakeholders in the future of urban water management. Recommendations were also intended to contribute to and inform the currently active stormwater expert panel engaged by the SA Department for Environment and Water (DEW). This is a panel of experts with management expertise which has been established to determine clear responsibility for private local, public local and regional drainage.

1.2 Scope

In the establishment of the independent panel for this project, and with the guidance of the stakeholder reference group comprised of representatives from SA Water Corporation, industry groups, and local and state government, two key aspects of the project scope were established to ensure the research focus was achievable:

- Geographical focus - the project discussion was focused on the Adelaide metropolitan area with some consideration of state-wide implementation and equity. The importance of stormwater management is noted to be critical in regional areas, particularly in cities such as Mount Gambier where stormwater is directed to a limestone aquifer.
- While the project was proposed to consider recycled water including wastewater and stormwater, the project mainly focussed on stormwater. Wastewater was a resource that was noted to be centrally managed in metropolitan Adelaide by SA Water Corporation, and opportunities for improved management or on-ground actions for recycled wastewater was generally only considered in this project where it added opportunity for stormwater reuse governance or actions.

1.3 Background

As an initial step in this project, background papers were prepared for discussion and review by the independent panel members considering the governance, funding and policy objective, and the on-ground options objective. Background material relating to the current stormwater and waterway governance, funding and policy arrangements are presented in Section 1.3.1 based on material in the first background paper. Further background material relating to the current understanding of on-ground management needs for improving urban water management are presented in Section 1.3.2 based on material from the second background paper.

1.3.1 CURRENT STORMWATER AND WATERWAY GOVERNANCE, FUNDING AND POLICY ARRANGEMENTS

Stormwater and waterway governance, funding and policy in Australia

The current arrangements for the governance of waterways, drainage and recycled stormwater at the national level, including South Australia, have been previously studied by policy practitioners but comprehensive coverage of all aspects is seldom undertaken in the one place. The striking feature of governance models for stormwater and waterway management in Australia and internationally is their variety. This is complicated by the nature of drainage. In parts of Europe and North America, for example,

'combined sewerage systems' mean that wastewater sewers also convey urban stormwater (e.g. see Black and Veatch, 2021).

In Australia and New Zealand, stormwater systems are separate from sewers. The drainage system usually comprises underground networks of pipes and other infrastructure, which collect and convey urban runoff during rainfall events, away from streets and buildings.

This system of physical infrastructure comprises of the following (Government of SA, 2021a):

- Private local stormwater systems, operating within private property. e.g., roof gutters, downpipes.
- Public local (minor) stormwater systems. e.g., underground pipe networks, to remove stormwater from streets and footpaths to provide pedestrian safety, convenience and safe vehicle use.
- Public regional (major) stormwater systems, which convey flows from the minor network via large constructed channels or modified urban watercourses often including floodways to accommodate larger flows from heavier, less frequent rainfall events.
- Natural waterways that 'receive' urban stormwater runoff (in addition to other functions including habitat, biodiversity and social benefit)
- Water sensitive urban design infrastructure and other engineered infrastructure intended to detain or retain runoff volume from a catchment for reducing runoff volume (e.g. infiltration measures), reducing runoff peak flow rates (e.g. detention basins) or improving water quality (e.g. bioretention, constructed wetlands)

Using this typology of stormwater drainage components, Table 1 presents the urban stormwater drainage arrangements in case study areas of Sydney, Newcastle, Melbourne, Brisbane and Perth. Within it, management of stormwater is shared by landowners, local government and often also a regional drainage service provider (Government of SA, 2021a). These regional drainage service providers also usually deliver other water services, such as drinking water and sewerage. Despite the potential offered by integrating stormwater and other water services, these organisations have historically invested little in such innovations.

As shown in Table 1, in many Australian cities, stormwater management is a shared responsibility between a regional drainage organisation and local government and other organisations, with various model structures and approaches. In Victoria, New South Wales, and Western Australia, the water utilities Melbourne Water, Sydney Water, Hunter Water and Water Corporation of WA (respectively) operate as regional stormwater utilities, with some responsibility for regional (or major) stormwater systems (LGA SA, 2021a). Floodplain management in urban areas in Australia is generally the responsibility of local government in all jurisdictions except Melbourne where Melbourne Water are the regional floodplain management authority. Sydney Water are also starting to play a role in this area, and were recently announced as the trunk drainage authority for stormwater in the Western Sydney Aerotropolis with the remit to deliver regional stormwater solutions and integrated water cycle efficiencies by simultaneously providing potable water, wastewater and recycled waste and stormwater treatments and networks (Sydney Water, 2022).

Large water utilities, some privatised, are common in Europe and the United Kingdom (UK). In the United States of America (USA), water services are still largely a municipal function. In all jurisdictions, policy and regulation is generally provided by state/provincial or national government along with responsibility for management of natural resources and the environment.

Since the USA Environment Protection Authority introduced stronger regulation of pollution from stormwater and sewer overflows there has been a trend to create stormwater utilities. Based on data in 2021, there were 2057 stormwater utilities operating in the USA, with their numbers increasing annually (Campbell and Bradshaw, 2021). The governance and structure of these centralised stormwater utilities is as varied as the jurisdictions that they serve (Reese, 2018).

Table 1. Urban stormwater drainage responsibility and funding arrangements in case study areas of Sydney, Newcastle, Melbourne, Brisbane and Perth - adapted from (Government of SA, 2021a).

CITY	PRIVATE STORMWATER SYSTEM	LOCAL (MINOR) STORMWATER SYSTEM	REGIONAL (MAJOR) STORMWATER SYSTEM	DRAINAGE CHARGES
Sydney ¹	Private land owners	Local governments	Sydney Water & local gov.	Stormwater drainage service charge is determined by the independent pricing and regulatory tribunal, NSW
Brisbane	Private land owners	Local government (Brisbane City Council)	Local government (Brisbane City Council)	Brisbane City Council drainage services are supported through local government rates – noting that Brisbane City Council also receive stormwater discharged from surrounding council areas
Newcastle ²	Private land owners	Local governments	Hunter Water	Stormwater drainage service charge is determined by the independent pricing and regulatory tribunal, NSW
Melbourne	Private land owners	Local governments	Melbourne Water	Drainage charges subject to determination by the economic regulator, the Essential Services Commission of Victoria
Perth	Private land owners	Local governments	WA Water Corporation	Drainage charges set by state government for the WA Water Corporation ³

¹ Sydney Water manages stormwater in some of Sydney’s catchment areas and in the Rouse Hill area to the north-west (see link under the column Regional stormwater system coverage).

² Hunter Water also manages stormwater in some other catchments near Newcastle (see link under the column Regional stormwater system coverage).

³ The Economic Regulation Authority of WA may undertake inquiries and make recommendations to support government decision making.

Stormwater and waterway governance funding and policy in South Australia

There are multiple actors involved in some way for the management of stormwater and waterways in South Australia where Adelaide represents the largest urban area. These include local government, state government departments and statutory authorities or boards. Stormwater is governed by multiple different legislation and regulations (Government of SA, 2021a). A summary of actors and regulations is presented in

Table 2, based on data provided by the Local Government Association of South Australia (LGA SA) (LGA SA, 2021b).

There have been several policy initiatives aimed at improving waterway and stormwater management and implementing greening measures in the Adelaide environment. One such policy is often referred to as the state water sensitive urban design (WSUD) policy (Government of SA, 2013). This was the first state policy to formally recognise the benefits to be derived from integrating WSUD into SA’s urban environments. Key aims included to:

- improve water security and climate resilience;
- contribute to public health and wellbeing;
- help protect or improve the health of receiving water bodies and their ecosystems; and
- help reduce ecological impacts and support affordable living by reducing long term costs associated with water management.

Table 2. Responsible entities managing stormwater in Adelaide South Australia (SA), including associated legislation. Information has been adapted from LGA SA (2021b).

ORGANISATION	RESPONSIBILITIES	KEY RELEVANT LEGISLATION
Local government	<ul style="list-style-type: none"> Take measures (including building and maintenance of infrastructure) to protect their local government area from natural hazards. It is noted that there is currently no explicit need to manage natural hazards outside a local government jurisdiction. The reference to natural hazards is also generally taken to include flooding from stormwater runoff, but this is not explicitly stated in the Local Government Act 1999 (SA). Have a role to “manage, develop, protect, restore, enhance and conserve the environment in an ecologically sustainable manner ...” which extends to how stormwater is managed, driving much of the activity in harvesting across the state over recent decades Play a critical role in the land use planning process through their development and administration of development plans, which determine where and what kind of development can occur, including in flood prone areas Have a role in maintaining around 75% of roads (and stormwater fixtures installed to protect roads)¹ 	<ul style="list-style-type: none"> Local Government Act 1999 (SA) Planning, Development and Infrastructure Act 2016 (SA) Metropolitan Drainage Act 1935 (SA) South-Western Suburbs Drainage Act 1959 (SA)
Stormwater Management Authority	<ul style="list-style-type: none"> Provide oversight and coordination of stormwater management, including prioritisation of infrastructure works Assist state and local government in preparing policies and best practice Facilitate and coordinate preparation of stormwater management plans (SMP) with local government Provide funding under the Stormwater Management Fund (SMF) to support local government in the delivery of SMPs 	<ul style="list-style-type: none"> The Stormwater Management Agreement and Schedule 1A of the Local Government Act 1999 (SA)
Department of Environment and Water	<ul style="list-style-type: none"> Flood management hazard leader with specific duties in state-wide emergency flood management planning, including the development of a Hazard Plan Responsible for leading the development of state-wide strategy (such as the urban water strategy) and oversight of implementation of state-wide water policy e.g. Water for Good Management of specific stormwater assets identified in the Stormwater Management Agreement (e.g. Patawalonga) 	<ul style="list-style-type: none"> State emergency management plan under the Emergency Management Act 2004 (SA) Stormwater Management Agreement Water Industry Act 2012 (SA)
Landscape Boards	Have special powers to carry out works, including works undertaken for the purposes of stormwater management or flood mitigation	<ul style="list-style-type: none"> Section 31 Landscape South Australia Act 2019 (SA)
SA Department for Infrastructure and Transport	<ul style="list-style-type: none"> Responsible for overseeing the development and land use planning across the state Manages approximately 25 percent of SA’s road network Develops stormwater design standards and guidelines 	<ul style="list-style-type: none"> Planning, Development and Infrastructure Act 2016 (SA)
Infrastructure SA	<p>Independent body corporate established with several functions including:</p> <ul style="list-style-type: none"> to review and evaluate proposals for major infrastructure (projects greater than 50 million in value or other projects deemed ‘major’), to assess risks involved in planning, funding, delivering and managing infrastructure monitoring the delivery of major infrastructure projects reviewing completed major infrastructure projects providing advice to the Minister 	<ul style="list-style-type: none"> Infrastructure SA Act 2018 (SA)

¹ See: <https://www.sa.gov.au/topics/driving-and-transport/roads-and-traffic/road-responsibilities>

ORGANISATION	RESPONSIBILITIES	KEY RELEVANT LEGISLATION
SA Water	Responsible for the Sturt River Flood Control Dam, and the parts of Adelaide watercourses that it manages pursuant to the Metropolitan Drainage Act 1935 (SA) and the South Western Suburbs Drainage Act 1959 (SA)	<ul style="list-style-type: none"> • South Western Suburbs Drainage Act 1959 (SA) • Metropolitan Drainage Act 1935 (SA) • Schedule 1 of the Stormwater Management Agreement
SA State Emergency Services	Flood emergency control agency, responsible for coordinating emergency response following a flooding event	<ul style="list-style-type: none"> • State emergency management plan under the Emergency Management Act 2004 (SA)
SA Department for Health and Wellbeing	Responsible for developing policy and providing advice to other agencies and the public to prevent or minimise the adverse health effects of environmental hazards in the South Australian community. Role includes providing advice – not approval - to water providers, local councils, government agencies, and the public on the health implications of recycled water use (including wastewater and stormwater reuse).	<ul style="list-style-type: none"> • South Australian Recycled Water Guidelines 2012
Private landowners	Landowners, including owners of strata title property and other private landowners, have responsibilities for the condition of watercourses which pass through their land	<ul style="list-style-type: none"> • Environment Protection Act 1993 (SA) and Water Quality Policy • Natural Resources Management Act 2004 (SA)

The *30-Year Plan for Greater Adelaide (Government of SA, 2017)* sets six overarching targets that will define the future of urban development for metropolitan Adelaide and the urban growth areas through to 2045. All six targets are inter-related and influence Adelaide’s transition to a more liveable environment, and there is a strong focus on preserving and increasing the urban tree canopy. Related to this, the *Landscape South Australia Act 2019 (SA)* established regional landscape management boards across South Australia. For Adelaide, it established Green Adelaide as a new entity governed by an independent Board to address seven legislated priorities including water resources, biodiversity and urban greening which are set out in the Green Adelaide Landscape Plan 2021-2026 (Green Adelaide, 2021).

Recent amendments to the urban planning system seek to give effect to many of these policy objectives. State Planning Policies (SPP) introduced through the *Planning, Development and Infrastructure Act 2016 (SA)* promote WSUD and requirements for stormwater discharge management from developments. For example:

- SPP 2.3 aims to improve the design quality of the South Australian built environment and public realm
- SPP 5.4 aims to provide climate-ready development
- SPP 14.5 aims to ensure that South Australia’s water supply can support current and future needs, and
- SPP 15.4 aims to build resilience of communities, development and infrastructure to adverse impacts of natural hazards.

In addition, South Australia’s Planning and Design Code supports WSUD approaches at lot scale in new developments through various stormwater management-related performance outcomes and deemed-to-satisfy provisions (Anon, 2021b). For example, measures specific to retaining trees on development sites apply in some cases, and there are some requirements which could encourage minimum site perviousness and onsite rainwater tanks in residential settings to capture runoff for use.

Facilitating leadership and coordination to help deliver multi-objective stormwater management outcomes is a key aspect of the *Local Government (Stormwater Management Amendment) Act 2016*. This Act aims to facilitate the state and local government ‘Stormwater Management Agreement’, and planning of stormwater management by local government, by supporting the development and implementation of stormwater management plans (SMPs). It sets out the functions and operation of the South Australian Stormwater Management Authority to establish high-level strategic directions for stormwater management and planning within and across local government areas and co-invest in stormwater improvements using a ‘Stormwater Management Fund’ (Government of SA, 2021b). The ability of this unique governance arrangement to deliver

on expected outcomes is constrained by its reliance on limited funding from the state government. There is also a further limitation in that local government is spread across catchment boundaries and strategic, catchment scale projects often require multiple actors to collaborate which can occur (see for example, the currently active Eastern Regional Alliance for Waterproofing Eastern Adelaide) but requires initial steps to facilitate collaboration.

Stormwater and waterway funding in South Australia

At present, landowners pay for stormwater drainage through local government rates, general taxation and a landscape levy (the latter is used to support implementing sustainable stormwater management measures in some cases). This provides funding for the local government works, the Stormwater Management Fund and other landscape board, state and federal grant programs. The Stormwater Management Authority, which oversees and co-ordinates stormwater management, is reliant for funding on the Stormwater Management Fund. This fund in turn, relies on an annual state appropriation that has been provided to support drainage and stormwater outcomes for over 50 years (Government of SA, 2021a).

Governance arrangements for stormwater, waterways and catchment management in Adelaide have evolved over decades. There has to date been a tendency towards adding layers of policy, new functions and institutions to fill gaps or coordinate and align actions across multiple players. This is especially the case as more environmentally sustainable approaches have developed and the opportunity to use stormwater for urban greening and community benefits has unfolded. In light of this, there is a key concern regarding the lack of sustainable funding - according to (Government of SA, 2021a), “the amount [of funding] available will not be able to ensure an adequate level of flood protection through traditional infrastructure and also achieve other outcomes”.

1.3.2 EXISTING UNDERSTANDING OF ON-GROUND MANAGEMENT OPTIONS FOR IMPROVED URBAN WATER MANAGEMENT

Stormwater as a problem, opportunity and resource

The most recent statement of future urban water management directions, including aspects of recycled stormwater management, waterways and stormwater drainage was presented by the *Urban Water Directions Statement* (Government of SA, 2022a). The statement contained a useful illustration highlighting the variety of water volume sources and their approximate magnitude which forms a useful basis to any discussion of on-ground management needs (Figure 1). Key water supplies including Mt Lofty Ranges reservoirs, desalination, the River Murray and recycled wastewater represent a total of 170.2 GL which are broadly controlled by SA Water Corporation. However, stormwater represents the single largest source at approximately 135.6 GL and remains a significantly underutilised water resource. For example, of Adelaide’s stormwater, it is estimated that less than 4% is currently recycled through managed aquifer recharge (MAR) schemes (Government of SA, 2022b) (excluding passive irrigation reuse). There are many reasons for this – not least that much of this stormwater drains from urban catchments within hours to days and the limited available harvesting sites in built-up areas. However, due to the scale of this resource, improving the complex governance arrangements shown in

Table 2 and prioritising on-ground actions is important.

The driver for many on-ground needs for urban stormwater management were summarised by DEW (Government of SA, 2021a), presented as a series of risk statements below. These risk statements describe the driver for most of the on-ground actions suggested by preliminary work fed into the independent panel into on-ground actions.

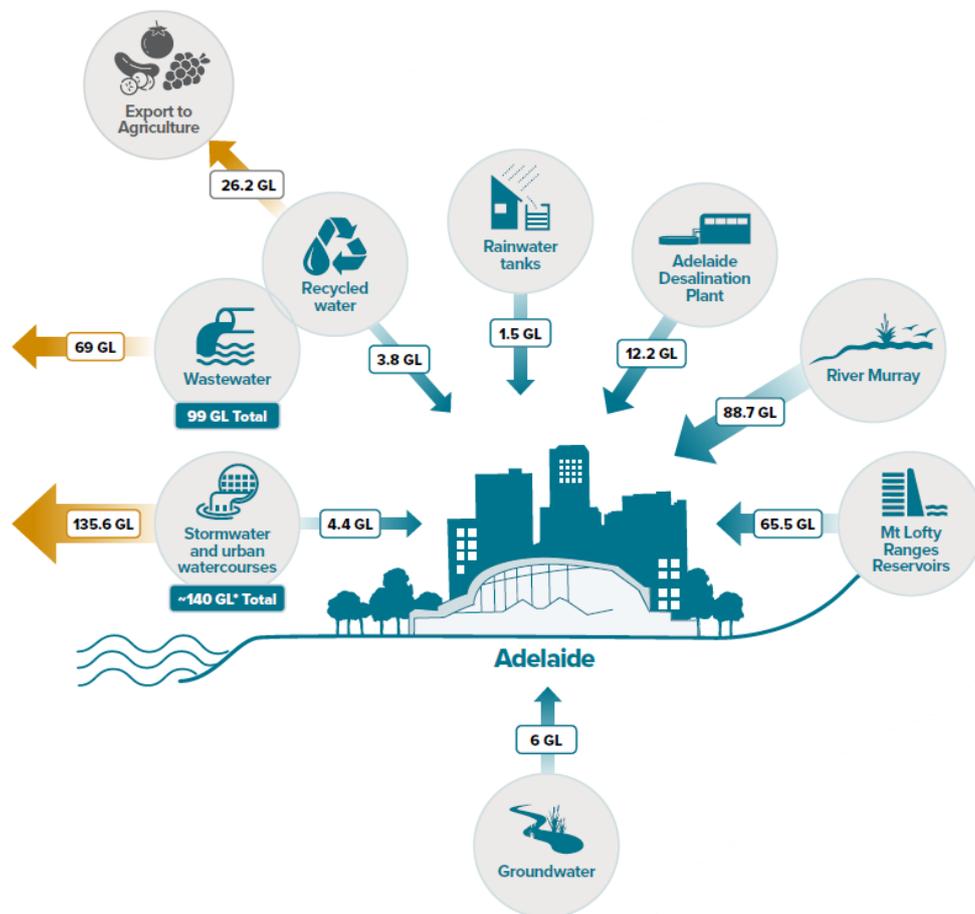


Figure 1. The water balance of urban Adelaide. Average annual volume quantities are shown based on an average of data from 2015/16 to 2019/20. *Stormwater is highly variable, with estimates ranging from 37 GL to 370 GL over this period. Source: Government of SA (2022a).

Table 3. Risk statements for urban stormwater management adapted from Government of SA (2021a).

RISK CATEGORY	RISK STATEMENT
Ageing infrastructure	Most infrastructure was built decades ago, particularly in the 1960s and will soon require replacement
Climate change	Current projections for Adelaide include increased storm severity, sea level rise, but a reduced overall volume of runoff on an annual basis
Urban development	The <i>30 Year Plan for Greater Adelaide</i> (Government of SA, 2017) encourages infill development to prevent urban sprawl into prime agricultural land. Infill development places greater demands on stormwater infrastructure with more runoff occurring from increased hard surfaces.
Changing urban lifestyles	In many areas, gardens are being reduced in size and replaced with hard surfaces (paving, sheds, carports) – more hard surfaces results in more stormwater runoff.
Demographic changes	More people living in towns and cities means more people may be exposed to flood risk.
Underappreciation of flood risk	Urban communities may be unaware that they live and work in flood prone areas. Many of those who have never experienced a flood may believe they face no flood risk and are ill prepared to protect themselves and their property from flood.
Emerging maintenance issues	Drainage infrastructure requires maintenance to work efficiently. Increased focus on WSUD may increase the cost of maintenance e.g. regular clean out of infrastructure like rain gardens to allow them to function.
Inadequate funding	Funding for stormwater is currently uncertain due to a lack of clarity around responsibility. Current spending is also inadequate to meet projected asset replacement requirements.

Stormwater and the need for flood control / drainage

At present, on-ground management needs for urban stormwater are many and varied. Fundamentally however, there is a growing need for investment into drainage and flood control infrastructure in South Australia. The spend by Adelaide's metropolitan councils on stormwater management between the 2014/15 and 2018/19 financial years was on average \$100 million per year, while regional councils spent an additional \$30 million per year over the same period. This spend is however dwarfed by the replacement cost - most urban drainage systems in the Adelaide metropolitan area were constructed in the 1950s onwards and are gradually reaching their design life – due to this, existing concrete drains are also known to be ageing, and approximately \$4 billion worth of stormwater infrastructure in Adelaide will need to be replaced in the next 50 years (LGA SA, 2021a). In addition to these ongoing works, SMPs have been developed by one or more local government entities to assess needs at a catchment scale, including flood management measures, stormwater quality improvement measures and opportunities for water harvesting and reuse². There are at least \$500 million in works already identified by approved SMPs in South Australia (Government of SA, 2021a), ranging from drainage upgrades, WSUD water quality measures and stormwater harvesting and reuse schemes. With many more plans currently under development in the Adelaide metropolitan area and regional centres, it can be expected that completion and approval of these plans will add hundreds of millions more in recommendations. SMPs represent a critical statement of what needs exist for urban drainage, flooding, harvesting and water quality improvement, and there is a need to ensure that urban drainage remains a priority in any consideration of flood management.

Stormwater and the need for improved catchment planning, liveability and natural ecosystems

There are other opportunities for urban water management which may not be directly considered by SMPs. One such example is the need to improve the extent of blue-green spaces in the urban environment. For example, many of Adelaide's urban waterways consist of concrete drains that support few community values aside from drainage. A typical concrete drain arrangement in Adelaide is shown in Figure 2, contrasted with an example of a more natural drainage alternative. Concrete drains rapidly convey stormwater with associated fine sediments and other contaminants to Adelaide's coast, contributing to the degradation of downstream waterbodies and coastal seagrass communities (Fox et al., 2007) and the quality of bathing waters. It should be noted that the image on the left of Figure 2 cannot be easily 'converted' to a more natural engineered approach like that on the right – it requires significant design and planning, and dedicated undeveloped open space, to safely convey flood flows. However, gradual improvements are possible that can restore some ecological value even to concrete channels and are highlighted in the *Urban Water Directions Statement* (Government of SA, 2022a).

Furthermore, natural stream banks and channels still need management. Previous reporting by the Goyder Institute for Water Research indicated that there has been very little investigation into the extent of stream bank and channel degradation in urban streams (Myers et al., 2021). After contacting several local governments to determine the level of knowledge regarding stream bank and channel management, it was apparent that there is little detailed work conducted in urban areas to identify this, despite numerous examples of stream bank and channel degradation occurring. Bank and channel degradation affects ecosystems and also mobilises sediment which is transported downstream ultimately reaching the Adelaide coast where it contributes to sea grass decline.

² A summary of SMPs in development and approved is available here: <https://www.sma.sa.gov.au/resources/stormwater-management-plans/>



Figure 2. A typical example of an open concrete drain (Morphett Vale, SA) compared to a natural channel arrangement (Mawson Lakes, SA).

Stormwater and the need for urban cooling

Adelaide is becoming hotter and drier, and without adaptation or intervention, urbanisation (sprawl and infill) and climate change will compromise the liveability of Adelaide due to extreme temperature events and the increased frequency and intensity of floods and droughts and their associated impacts on vegetation, waterways and coastal health. Concerns over urban heat island development in Adelaide are well documented (e.g. Clay et al., 2016), and have been acknowledged as a concern in development planning for Greater Adelaide via the current *30 Year Plan for Greater Adelaide* (Government of SA, 2017) (Figure 3) with measures adopted to maintain or increase the urban canopy for some development categories in the current *SA Planning and Design Code*.

Cooling our cities

—



2016



2070



Adelaide's average number of hot days above 35° is predicted to increase by up to 47 days per year by 2070.



Despite our hot, dry climate, we can mitigate the urban heat island effect by growing our urban tree canopy and retaining water in urban landscapes.

Figure 3. Urban heat island impacts and the benefits of urban cooling as presented in the 30-Year Plan for Greater Adelaide. Source: (Government of SA, 2017).

The link between irrigated open space and urban cooling is widely acknowledged. A prominent case study in Adelaide which demonstrated the benefits of irrigated landscapes was the Adelaide Airport irrigation trial. This project revealed the cooling benefits of using urban stormwater runoff for irrigating turf. Findings at this site indicated that the above ground temperature of the irrigated area was on average 1.8°C cooler than the surrounding non-irrigated turf (Qian et al., 2020). The benefits associated with cooling urban spaces is accepted, resulting in SA Water launching a 'cooling the community' initiative in collaboration with local government. This involves smart irrigation controls, soil moisture sensors and temperature sensors being rolled out in public play spaces to assist with cooling temperatures in community spaces³.

Stormwater and coastal water quality

According to Tanner and Thiel (2016), there has been a total of 6,200 ha of seagrass lost from Adelaide's coastal waters since 1949. This is from shallow and deeper waters and has been attributed to both nutrient pollution and turbidity in wastewater, stormwater and natural stream discharges to the Adelaide coast. The key causes of sea grass decline were identified in the Adelaide Coastal Waters Study (Fox et al., 2007) and there have been several policy measures and strategies developed by the South Australian Environment Protection Authority to reduce seagrass decline (McDowell and Pfennig, 2013).

In general, the water quality of flow into St Vincent Gulf from Adelaide has improved in recent years due to reduced nutrient loads. These improvements have been largely achieved by investment to improve the water treatment performance of the main municipal wastewater treatment plants in Adelaide, at Bolivar, Glenelg and Christies Beach (Cheshire, 2018). There have also been some improvements in the management of urban stormwater through uptake of harvesting opportunities, implementation of constructed water sensitive urban design (WSUD) measures and gradual improvements to urban stream systems (Myers et al., 2013). However, fine sediment, sediment and nutrient inputs from urban runoff to St Vincent Gulf continues to be a concern, with the additional concern that fine sediments already deposited along the coast are known to resuspend during large storm events (Fernandes et al., 2018, Zijl et al., 2014).

2 Independent Panel Engagement Process

To achieve the objectives of this project, two panels of research experts were formed. One panel considered the options for future governance, funding and policy (GFP independent panel) (Section 2.1), while the other independent panel considered on-ground management options (OG independent panel) (Section 2.2) for urban water management in Adelaide, with a focus on stormwater in each case. Figure 4 outlines the process from engagement through to forming recommendations for each of the two independent panels.

³ For more details of the 'cooling the community' initiative of SA Water, see <https://www.sawater.com.au/education-and-community/community-and-events/cooling-the-community>

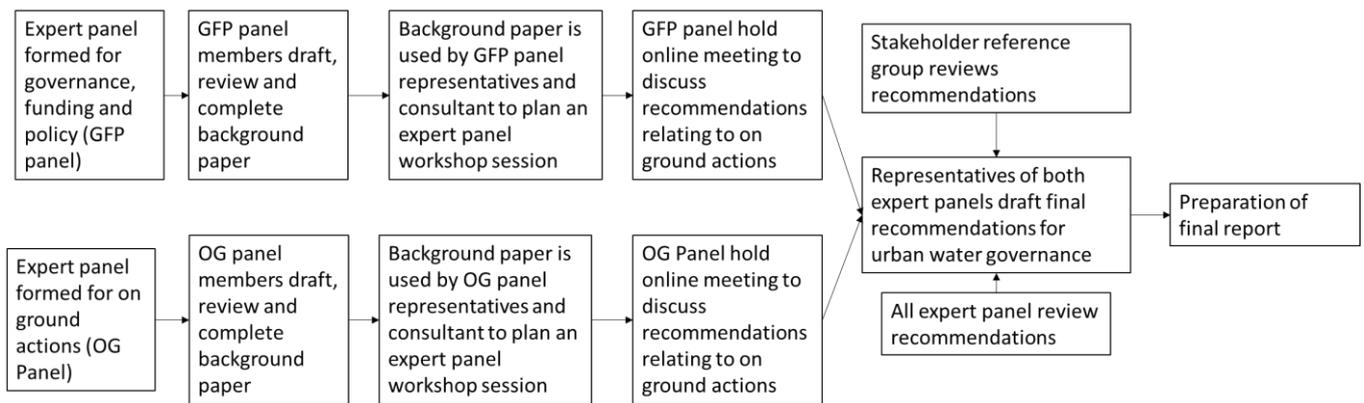


Figure 4. Framework of how each independent panel operated with feedback from the stakeholder reference group to develop, refine and produce recommendations of this report.

2.1 Options for future urban water and waterway governance, funding and policy arrangements

The governance, funding and policy (GFP) independent panel, was formed in November 2021 and involved a range of urban water experts shown in Table 7. The GFP panel was involved in the preparation and refinement of a background paper, workshop and online sessions, and the development and review of recommendations for future urban water and waterway governance, funding and policy arrangements.

Table 4. Members of the Goyder Institute’s independent panel investigating options for future urban water and waterway governance, funding and policy arrangements (listed in alphabetical order by surname).

NAME	TITLE	ORGANISATION
Mellissa Bradley	Program Manager	Water Sensitive SA
Chris Chesterfield	Professor of Practice	Monash Sustainable Development Institute, Monash University
Lin Crase	Professor of Economics	UniSA Business, University of South Australia
Tim Muster	Principal Research Scientist	Adaptive Liveable Cities Team, CSIRO Land and Water
Baden Myers	Research Fellow	UniSA STEM, University of South Australia
Bruce Naumann	Manager	Salisbury Water, City of Salisbury
Melissa Nursey-Bray	Director, Adaptation, Community Environment Research Group	School of Social Sciences, The University of Adelaide
<i>Additional people present during the GFP independent panel session</i>		
Kane Aldridge	Director	Goyder Institute for Water Research
Rachel Barratt	Technical Director	Water Advisory, People and Places, Jacobs
Daniel Pierce	Senior Research & Development Officer	Goyder Institute for Water Research

The GFP independent panel first developed a background paper reviewing governance of stormwater in South Australia and with comparison to governance at the national level (Chesterfield and Dobbie, 2022). The paper was drafted and distributed to the panel with a period of online commentary and refinement

undertaken by email. Using this, the GFP independent panel workshop was planned with the assistance of an external consultant (Rachel Barratt, Jacobs) and held on Tuesday 8 February 2022 via Microsoft Teams. A copy of the Workshop Agenda is provided in Appendix A. The workshop included:

1. a presentation session based on a background paper that had been distributed to participants
2. a brief discussion of whether there is a case for change in the governance of stormwater
3. a brief discussion on, should there be a need for change, why it has not occurred
4. a discussion developing policy options based on the background paper
5. generating ideas on the potential means to evaluate the overall benefits and limitations of key policy changes identified.

Following the presentation in item one above, the workshop discussion was facilitated through the Mural Board online workshop tool. Ideas generated in the workshop session were subsequently documented as a tabulated summary of options for alternative governance, as well as their perceived benefits and costs with respect to the identified evaluation criteria. These were provided to the GFP independent panel for consideration and feedback and this discussion was then refined by panel members following in the weeks following the workshop through review and commentary via email correspondence, culminating in a series of key recommendations on which members of both independent panels could achieve a consensus (Recommendations 1 to 4 in Section 3).

2.2 Integrated on-ground management options for urban water

The on-ground management independent panel members (OG independent panel) who participated in the preparation and refinement of a background paper, the independent panel workshop and the development and review of recommendations for on-ground management options are shown in Table 8.

Table 5. Members of the Goyder Institute’s independent panel investigating integrated on-ground management options for urban water (listed in alphabetical order by surname).

NAME	TITLE	ORGANISATION
Mellissa Bradley	Program Manager	Water Sensitive SA
Tanya Doody	Principal Research Scientist	Managing Water Ecosystems Group, CSIRO Land and Water
Howard Fallowfield	Professor	College of Science and Engineering, Flinders University
Huade Guan	Associate Professor	College of Science and Engineering, Flinders University
Martin Lambert	Professor	School of Civil, Environmental and Mining Engineering, The University of Adelaide
Tim Muster	Principal Research Scientist	Adaptive Liveable Cities Team, CSIRO Land and Water
Baden Myers	Research Fellow	UniSA STEM, University of South Australia
Margaret Shanafield	Senior Research Fellow	College of Science and Engineering, Flinders University
<i>Additional people present during the OG independent panel session</i>		
Kane Aldridge	Director	Goyder Institute for Water Research
Rachel Barratt	Technical Director	Water Advisory, People and Places, Jacobs
Daniel Pierce	Senior R&D Officer	Goyder Institute for Water Research

Like the GFP panel, the OG panel first developed a background paper reviewing on ground actions required to improve stormwater management in South Australia based on previous reporting by state government, the Goyder Institute for Water Research and other sources (Myers, 2022). The paper was drafted and distributed to the panel with a period of online commentary and refinement undertaken by email. Using this groundwork, the OG independent panel workshop was planned with the assistance of an external consultant (Rachel Barratt, Jacobs) and a workshop was held on Wednesday 30 March 2022 via Microsoft Teams. A copy of the Workshop Agenda is provided in Appendix A. The workshop included:

1. a presentation session based on a background paper that had been distributed to participants
2. a short background discussion regarding the opinion of individual panel members reflecting on what on-ground actions Adelaide, and South Australia, have done well
3. a discussion session developing on-ground actions in the category of stormwater management, wastewater management and water recycling
4. consideration of the ideas generated above and prioritising them via the allocation of votes
5. reflection and ongoing discussion to refine the ideas which received the most support.

Following the presentation in part one above, the remaining aspects of the discussion were undertaken using the Mural Board online workshop tool. Voting during the session was undertaken by sorting and collating ideas and providing each of the nine OG independent panel members with five 'votes' with which they were able to use in support of their 'top five' action ideas. Ideas generated in the workshop session were subsequently documented as a tabulated, ranked summary of actions and sub-activities based on the online discussion. These were provided to the OG panel for consideration and after feedback and this discussion was then refined by panel members through drafting and commentary via email correspondence, culminating in a series of key recommendations on which members of both independent panels could achieve a consensus (Recommendations 5 to 8 in Section 3).

2.3 Stakeholder Reference Group

A Stakeholder Reference Group (SRG), consisting of stakeholders from local government, state government and industry bodies was formed to add value to the project development and output by providing practical advice on the independent panel findings. The GFO and OG panels included various representatives particularly from research providers, but few practitioners from state and local government. As such, the SRG was formed to collect and consider commentary from those who would be affected by or charged with implementing any recommendations. The role of the project reference panel consisted of four main functions:

1. Discuss progress and relevance of interim project results, and provide feedback to the project team on the application and implications of project results to SA Government agencies and other key stakeholders;
2. Facilitate communication linkages and synergies between the project team and other local, national and/or international researchers and stakeholders involved in similar or closely related work, and assist the project team in communicating its results to the most appropriate stakeholders and end-users, including government;
3. Assist the project team in gaining access to relevant information, resources and data, held by local and state government and the private sector;
4. Where appropriate, provide advice on the peer-review process for the draft research report and other project outputs authored by the project team.

A list of the SRG members is shown in Table 6.

Table 6. Members of the stakeholder reference group who provided commentary on project methodology, recommendations and links to other industry stakeholders (listed in alphabetical order by surname).

NAME	TITLE	ORGANISATION
Hannah Ellyard	Manager Urban Water Strategy	Department for Environment and Water, SA
Dave Gorge	Senior Manager Government and Key Stakeholder Relations	SA Water Corporation
Brenton Grear	Director	Green Adelaide
Laura Hodgson	Policy Officer	Local Government Association, SA
Andrew King	Chair (and Coordinator Engineering Services)	Stormwater South Australia (and City of West Torrens)
Rachael Neumann	Manager Key Stakeholder Relations	SA Water Corporation
Glynn Ricketts	Water Resources Coordinator	City of Marion
Katherine Russell	Manager, Policy Projects	Local Government Association, SA
Andrew Solomon	Manager Environmental Science	Environment Protection Authority, SA
David Trebilcock	General Manager	Stormwater Management Authority

Key interactions with SRG related to affirming the proposed methodology (Figure 4) and providing an assessment of the independent panel recommendations including their benefits, costs, caveats and ‘potential to implement’. The SRG input had some impact on the adopted terms used in recommendations, while other considerations that were brought up in discussions are detailed with the independent panel recommendations in Section 3. Key interactions with the SRG included the following:

- 17 February 2022 – online meeting to review the project progress and methodology
- 20 May 2022 - online meeting to consider initial review the project recommendations – verbal feedback received and worked into ongoing refinement of recommendations in consultation with independent panels
- 2 June 2022 – online meeting to review project recommendations (recommendations were circulated prior to the meeting resulting in both written and verbal feedback).

All feedback of the SRG was limited to advice, with the independent panel having authority to consider whether and how the advice was to be considered.

3 independent Panel Findings and Recommendations

In this section, the findings of the GFP and OG independent panels are presented as separate activities. The findings of the GFP independent panel to develop options for future recycled stormwater and waterway governance, funding and policy arrangements are presented in Section 3.1. The findings of the OG independent panel exploring integrated on-ground management options for urban water are presented in 3.2.

3.1 Options for future recycled water and waterway governance, funding and policy arrangements

3.1.1 GFP INDEPENDENT PANEL GOALS AND PERCEIVED BARRIERS TO CHANGE IN STORMWATER GOVERNANCE

The GFP independent panel began their session by noting what they would like to achieve in the process of considering alternative governance measures as a independent panel. Input from GFP panel members to this initial discussion was by brief notes on the Mural Board system and included the following key goals which were only briefly discussed:

- An improved governance model for urban stormwater
- Clarity on a preferred governance model, identifying positive and negative aspects of it
- To elevate stormwater to a similar status with potable and wastewater, and produce a model where waterways provide amenity, community connection and ecological function
- To be able to explain why stormwater management is crucial, in the context of extreme heat, cooling and liveable cities
- To establish clear standards for stormwater management and levels of service.

The panel was also asked to consider the question - what barriers exist to achieving improved urban water management? Outcomes from this discussion were grouped into themes included the following key points:

- Overcoming inertia (that is, overcoming a lack of existing momentum to consider options for improving stormwater management, select the desired outcome and implement it)
 - Change is held back by shifting priorities of government and a focus on short-term returns/costs
 - Lack of any ‘crisis’ situation to force action – drivers including climate change and liveability are seen as a long-term issue, not immediate concerns
 - Ecosystem degradation is perceived as inevitable by stakeholder. e.g. the public
 - Lack of clarity about the need for change
 - A need to start the conversation for reform - it is not going to happen overnight.
- Current governance position of stormwater
 - Lack of understanding regarding the value proposition for better stormwater/waterway management to enhance community wellbeing and environmental health
 - Stormwater discharge impacts are not recognised in South Australian Acts and regulations, with no framework for ‘user pays’ charges like those that exist for point source pollutant sites.
- Funding arrangements
 - South Australia is not wealthy compared to other Australian states so funding needs are difficult to argue. e.g. calling for funding to address stormwater management requirements is more difficult when other government programs also require more funding
 - Improved management restricted by a lack of sustainable funding sources.

3.1.2 THE NEED FOR CHANGE AND ALTERNATIVE GOVERNANCE MODELS

Following this initial discussion noted in Section 3.1.1, there was a consensus from the GFP independent panel that there was a need for change in governance arrangements, culminating in the development of Recommendation 1 to describe the need for a change in the governance of stormwater.

Recommendation 1

Transition to integrated urban water management arrangements for achieving economic, cultural, environmental and social outcomes for Adelaide, considering the benefits, costs and risks of alternative models.

Rationale: The current model of urban water management has seen success but there are opportunities to clarify responsibility and improve financial sustainability for stormwater management. The panel agreed that the current arrangements for stormwater management are not clearly defined, with several local and state government entities having an interest but not necessarily an obligation by legislation to manage stormwater. This lack of clarity in responsibility inhibits the ability of government and industry to adopt the changes required to better support urban drainage, flood control, improved stream and coastal environmental quality and go the next step toward applying stormwater for greening and liveability. It was recommended that responsibility be clarified and a new governance model implemented with financial sustainability.

Suggested initial step(s): Following the completion of Strategy D.1 and D.2 of the SA Government *Urban Water Directions Statement* (the currently active 'Minister's stormwater expert panel' including management expertise which has been established to determine clear responsibility for private local, public local and regional drainage), pursue a formal cost benefit analysis and risk assessment of the recommended options. The independent panel developed and discussed the potential benefits and costs of five options for alternative stormwater management that have potential to clarify responsibility and produce a funding model that is reflective of the true value of stormwater management.

The GFP independent panel identified five potential options to improve the governance and policy relating to urban water, particularly recycled stormwater, waterways and drainage. The five options were developed during the independent panel session by the GFP panel members with some influence from the background paper prepared for the session and prior email discussion around the content of this paper, which included elements of these ideas (Chesterfield and Dobbie, 2022). The five options to improved governance were:

- Incorporating management of urban water, including stormwater, into an existing utility – for Adelaide, the most reasonable outcome of this would be creating a SA Water in house business focussing on 'waterways'
- Modifying the current system by incorporating governance of urban stormwater into Landscape Boards – in the case of Adelaide, for example, management responsibility would reside with Green Adelaide
- Modifying the current system of stormwater governance by establishing regional entities drawn from local government – adopting a 'Regional subsidiary' approach to manage at catchment scale
- Modifying the current system of stormwater governance by expanding the role of the Stormwater Management Authority such that it takes a larger role in governance
- Developing a separate entity by establishing a separate utility for managing stormwater runoff and recycled stormwater.

The GFP independent panel proceeded to develop strategies to assess the merit of each of these options. It was agreed that any change in the management of stormwater should:

- be able to deliver multiple objectives/outcomes including flood protection, liveability, sustainability and resilience
- have the capacity to serve all regions of South Australia
- create an organisational culture that can adapt to community expectations and environmental change, as well as resist political change
- have an integrated urban water management focus
- have a sustainable source of funding which can deliver objectives at reasonable costs to consumers

- be accountable for decisions and outcomes and use of funding
- operate at an appropriate scale (many councils were perceived by the GFP panel to be too small to resource the multiple facets of stormwater management)
- have clear objectives and functions.

Based on these requirements, the five developed options were then discussed by the GFP panel under the following eight categories, with the discussions summarised in Table 7. When assessing each option under these categories, there was limited time for formal assessment. Merit of each option should be considered further using these initial perceptions as a starting point in any transition planning.

1. Financial sustainability
2. Ability to deliver integrated water management objectives
3. Extent of legislative change required
4. Potential to adopt change and present a long-term option
5. Ability to transition to change incrementally
6. Ability to operate at regional scale, i.e. across local government boundaries
7. Ability to balance objectives including flooding, water quality, stormwater and wastewater
8. Other.

The GFP independent panel discussion of each of the five management options based on the eight categories above was given a qualitative assessment of ‘potential for success’ as ‘low’, ‘medium’ or ‘high’. For example, the potential for financial sustainability of Option 1 (incorporating stormwater management into an SA Water in-house business) was generally perceived by the GFP panel to be high. These qualitative descriptions should be considered as preliminary and the discussion in Table 7 describe why ratings of low, medium or high were assigned and where relevant the limiting factors that will influence success under each of the eight categories.

Table 7. Summary of the Goyder Institute’s GFP independent panel commentary on the five options identified for future stormwater and waterway governance.

OPTION	1: SA WATER IN-HOUSE BUSINESS	2: GREEN ADELAIDE BASED ENTITY	3: REGIONAL ENTITIES DRAWN FROM LOCAL GOVERNMENT – REGIONAL SUBSIDIARY	4: EXPAND THE ROLE OF THE STORMWATER MANAGEMENT AUTHORITY (SMA)	5: STAND-ALONE ENTITY
<p>Description</p>	<p>This model was developed with reference to the model of Melbourne Water, which was generally perceived as a successful model in Victoria.</p> <p>Under this model SA Water would be charged with overseeing the ‘major stormwater trunks’ outlined by Government of SA (2022a)</p> <p>SA Water could charge for the service and government would need to set standards and targets, possibly through a strategy. Initially a separate business unit in SA Water would need to be established possibly with a – Waterway Advisory Committee (example)</p> <p>Under this model it was considered that the SMA may cease to exist, or adopt a different role..</p>	<p>Under this model, stormwater management in Metropolitan Adelaide would be passed on to Green Adelaide, who already have an interest in green infrastructure, stormwater, particularly stormwater quality and flooding through funding works.</p> <p>Change would mean that Green Adelaide would take on broader functions which need to be determined and negotiated with local government with additional funding (from local government, or from the community) to provide the service.</p> <p>If successful and desirable, the model could roll out to all Landscape Boards in South Australia.</p> <p>Under this model it was considered that the SMA would cease to exist.</p>	<p>In this model regional entities would be established – metropolitan Adelaide scale, or smaller, based on catchment boundaries - which includes representation by local governments and private providers operating within the boundary.</p> <p>This model will need to be driven by local government and equitable to all participants in terms of service level and funding.</p> <p>Examples of this model which have currently been established for more specific needs include the collection of local government working on the Brown Hill Keswick Creek Stormwater Project focusing on the implementation of the Brown Hill Keswick Creek Stormwater Management Plan(SMP), or the Eastern Region Alliance focussing on waterproofing eastern Adelaide through measures including stormwater harvesting.</p>	<p>Under this model the current role of the SMA function would expand beyond flooding to explicitly include a broader remit and its funding would also need to be reviewed.</p> <p>Could be like Option 3, where the SMA lead the negotiations among councils to form subsidiaries and drive agreements. Could also be a regulatory or supervisory role over Option 5.</p>	<p>Establish a new entity with responsibility for stormwater and urban waterway management. The model could include just flooding and drainage or a more expanded remit covering other stormwater goals such as harvesting.</p> <p>This model would require legislative change but provides the opportunity to build something fit for purpose.</p> <p>Likely to sit on the <i>Water Industry Act 2012 (SA)</i> as a utility similar to Option 1 – only difference is SA water would not be the utility, rather a contract with minimum service levels and responsibilities could be put to tender.</p>

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Financial sustainability	<p>High</p> <p>Would require a funding model but there is already an ability for billing to occur and the entity would reside in an existing large organisation.</p>	<p>Medium</p> <p>A Landscape levy exists and there is potential to modify for more explicit stormwater management components.</p> <p>Any change may be subject to political pressures – cost of any stormwater management relief for councils will need to be transparent.</p>	<p>Low to High</p> <p>Will vary - funding through provision of services under the Water Industry Act 2012 (SA), and possibly the SMA, could lead to high financial sustainability through a cost recovery model. But other arrangements may or may not be sustainable.</p> <p>Concerns noted that the collection and distribution of recycled stormwater may experience difficulty competing with SA Water on pricing.</p> <p>May require additional funding for all services – for example, the revenue that can be collected may not be adequate to cover all costs, especially those that are difficult to charge for such as greening spaces, education and other activities that improve liveability. Therefore, other top up funding may be required.</p> <p>Will depend on commitment of councils to ‘buy in’ to the subsidiary.</p>	<p>Low</p> <p>Budget limited to a government distribution, would need supplementing and is not sustainable or cost efficient- i.e. aligned with the cost or value of the service – it is in effect a grant.</p>	<p>High</p> <p>It would operate as a utility under the Water Industry Act 2012 (SA) and funding generated like a utility - challenge will be competing with SA Water - but additional funding could be provided by government for some services.</p>

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Perceived ability to deliver integrated water management objectives	<p>Medium</p> <p>Would require a change in focus in SA Water as host to recognise all three sources of water (mains water, recycled wastewater and recycled stormwater) and the appropriate management of runoff for urban safety and liveability. Will require development of new capabilities – can be addressed through (say) a new division and advisory board.</p> <p>Need to be careful to avoid duplicating roles in SA Water, DIT and local government.</p>	<p>Medium/ Low</p> <p>Perceived strong focus on greening, but currently not drainage with little in house capability, for drainage.</p> <p>Green Adelaide currently uses DEW staff for project delivery – would require greater clarity on the funding model between Green Adelaide and state government.</p> <p>Need to be careful to avoid duplicating roles in Green Adelaide, DIT and local government.</p>	<p>High</p> <p>At present, local government already has the highest level of experience and (to some extent) responsibility for implementing stormwater management plans, flood protection, liveability, water quality improvement and environmental protection.</p> <p>May require a new charter to state what each entity is responsible for (and what council no longer will be).</p>	<p>Medium</p> <p>The current <i>Stormwater Management Authority Strategic Plan (Stormwater Management Authority, 2015)</i> indicates need for interest in flooding and other aspects of stormwater. This included stormwater reuse, greening and other environmental and social benefits. However, the SMA currently have limited staff so don't have the capability or capacity to take up responsibility immediately.</p> <p>Need to be careful to avoid duplicating roles of SMA, DIT and local government.</p>	<p>High</p> <p>As a new entity has ability to develop this focus from the outset. Would require explicit statement on what the role will be and will also need oversight to ensure minimum standards are being met.</p> <p>Careful consideration required on how this entity works with local government and SA water to achieve blue/green benefits more broadly.</p> <p>There is potential that councils may 'opt out' of contributing and manage as is – compromising effectiveness?</p>
Extent of legislative change required	<p>Medium</p> <p>Amendments anticipated to be required for the Water Industry Act 2012 (SA) and possibly to the Local Government Act 1999 (SA).</p>	<p>High</p> <p>Amendments anticipated to be required for the Water Industry Act 2012 (SA), the Local Government Act 1999 (SA) and the Landscape Act 2019 (SA), likely others.</p>	<p>Low</p> <p>Broadly considered to be possible without legislative change.</p>	<p>Medium</p> <p>Would require amendments to Local Government Act 1999 (SA), Water Industry Act 2012 (SA), and likely others.</p>	<p>Medium</p> <p>May require amendments to Local Government Act 1999 (SA), Water Industry Act 2012 (SA), and likely others – depending on who will regulate targets and performance of the entity.</p>

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<p>Potential to adopt change as a long-term option</p>	<p>Medium</p> <p>Change would establish stormwater management as part of a large existing institution also managing potable water supply and wastewater. Success would depend on the funding model, political support and equity of service delivery. As an example, perceptions (real or manufactured) of over allocation of resources to one region over another may compromise the success of this model long term if expectations are not well managed with (say) local government partners and state political actors.</p>	<p>Medium</p> <p>Flexibility to incorporate the change expected to be high given recent changes in the institution (transition from Natural Resource Management Board to Landscape Board). However, rated as medium as success would depend on the funding model, political support and equity of service delivery. As an example, perceptions (real or manufactured) of over allocation of resources to one region over another may compromise the success of this model long term if expectations are not well managed with (say) local government partners and state political actors.</p>	<p>Medium</p> <p>Considered broadly flexible to adopt the change – councils are well established and have experience and local knowledge. Subsidiaries have been formed in the past for water harvesting development. Drawback is that the subsidiary is dependent on goodwill and cooperation between multiple council entities (which may change over time) and any private partner (the permanence of which is subject to financial sustainability and other changes such as corporate acquisition). Most councils will probably have to be part of multiple subsidiaries if adopting (say) catchment boundaries as a focus of each subsidiary which may be an administrative burden compared to the ‘as is’ approach.</p>	<p>Medium</p> <p>A change in responsibility to SMA will broaden the scope of operations for an already active participant in stormwater management in the state. Success would depend on the funding model, political support and equity of service delivery. As an example, perceptions (real or manufactured) of over allocation of resources to one region over another may compromise the success of this model long term if expectations are not well managed with (say) local government partners and state political actors.</p>	<p>Medium</p> <p>This option is initially flexible in that it may be small to large scale depending on where it is implemented, and implementation may be periodically reviewed as part of the entity life cycle. The adoption of a private partner is restricted by the commercial nature of the entity – for example, a failure of the business model for agreed entity or commercial acquisition of the entity buy other business interests will compromise delivery of services.</p>

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Ability to transition to change incrementally	Medium To some extent - would require legislation change and an establishment period in SA Water which is not incremental but could commence on trial areas such as a regional centre, or a portion of metropolitan Adelaide.	Medium To some extent – initial work required to find out what change to legislation is needed and if some of it could be incremental - but this would be a risk - if not all powers were provided in one transition, then the process could become confusing because for a period of time the entity has expectations to deliver on certain outcome without the powers to effectively do it. There is a potential to trial the transition of stormwater management to Green Adelaide or another Landscape Board before making changes state-wide (if desirable).	High Yes – due to the anticipated lower level of legislative change required, trial subsidiaries could be established with councils opting in throughout metropolitan Adelaide and regional South Australia. Existing councils can ring in their existing understanding. Success of trials may encourage other subsidiaries to form.	Medium The SMA is already established- but would need a clear strategy and plan to get take on more responsibility and to define what that responsibility is. May be implemented in a trial manner at individual council or catchment scale (with one or more councils participating in the trial).	Medium to High Will depend on scale - would need to establish what the private entity is going to be responsible for and implement it – but entities may assume responsibility incrementally in targeted areas, or areas of interest by private organisations. Option may be implemented in a trial manner at individual council or catchment scale (with one or more councils participating in the trial).
Ability to operate at regional scale i.e. across local government boundaries	High SA Water has an established state-wide presence in urban centres – can potentially be applied to metropolitan Adelaide (or some other trial area) and then expanded.	Medium Implementation would be limited to the geographical boundary of Green Adelaide; however, a similar model could roll out to all Landscape Boards if successful.	High The very model is based on multiple councils in cooperation with a private entity working at a more appropriate scale (e.g. catchment scale).	High SMA currently operates with a state-wide focus and would not be restricted by geographical boundaries within SA	High Not geographically restricted as starting from scratch. Implementation would be contingent on setting a boundary of operations (which is flexible, could be local government boundaries or a catchment boundary with multiple local government partners).

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Ability to to balance objectives including flooding, water quality, stormwater and wastewater	Medium to High Considered medium to begin with as historically SA Water has had little focus on stormwater management for flooding, but some consideration of stormwater reuse. Well established for wastewater and meeting performance targets. However, based on their experience meeting current targets, once established the ability would be high.	Medium Green Adelaide has an existing interest in the improvement of stormwater management including flooding and water quality, less so with wastewater.	High Subsidiary considered strong for flooding, water quality and stormwater objectives in particular – it resolves the inability of small councils which may not have internal capacity to address all objectives. Contingent on defining who the subsidiary is held responsible to – could be local government, SMA, Green Adelaide and/or EPA.	Medium If expanded, SMA could complement the flood management component in conjunction with other targets delivered by expanding current expertise or adopting delivery partners such as Green Adelaide and/or local government subsidiaries.	Medium – High Considered high, particularly if under the Water Industry Act 2012 (SA). But could be subject to shareholder or business interests (profit motive). Contingent on defining who the private entity is held responsible to. If established under the Water Industry Act 2012 (SA) then it would be Essential Services Commission of South Australia or the SA Office of the Technical Regulator – else it could be local government, SMA, Green Adelaide, Department of Health and/or Environment Protection Authority (EPA SA).

During follow up discussion of Recommendation 1, it was agreed that undertaking further examination of alternative management approaches was warranted. It was noted that adopting this measure as a state-wide approach would need to be carefully considered however. After trialling the approach in the Adelaide metropolitan area, it was noted that there is potential for unintended consequences if a single solution in all or part of Adelaide was implemented across metropolitan and regional townships. It was also suggested that any changes in management responsibility would need to consider input from local government entities who currently manage the bulk of stormwater management and flood control activity at the local scale in SA.

At this point, it is worth noting that the discussion of the panel members reflects a need to consider an understanding of how governance of stormwater can effectively transition to embrace new approaches. For example, Rijke et al. (2011) undertook a governance analysis based on review and surveys across water managers in South Australia in 2010 around the time that the Department for Water (now DEW) was established. The authors identified that there was a need to balance strategic planning and opportunistic embrace of opportunities. Related to this was a need to balance governance that is centralised enough to make change happen, but localised enough to be implemented well. The final point was for government to value the potential of networks to ensure advocacy, learning and replication, much of which may be seen to be greatly assisted by the activities of Water Sensitive SA, established since the publication by Rijke et al. (2011).

During the discussion of the alternative governance options above, and based on recognition of the need to elevate stormwater to a similar status to potable and wastewater and the limited recognition of stormwater discharge impacts in South Australian Acts and regulations (Section 3.1.1), the GFP independent panel developed Recommendation 2, with subsequent immediate actions to undertake the required change.

Recommendation 2

Update the *Water Industry Act 2012* and other legislation to enable new governance arrangements to manage stormwater for flood control and as integrated water resources for achieving economic, cultural, environment and social outcomes.

Rationale: At present, the responsibility for stormwater is not defined clearly in state legislation. Changes are required to the Water Industry Act (2012) and other related Acts and regulations to formalise the current arrangements, or to enable the implementation of alternative management options like those in Recommendation 1. The actual changes will depend on the approach selected. A key requirement is that stormwater should be considered within the definition of the 'water industry' as part of any adopted change. The Act should also be updated to ensure that the economic regulation of investments into improved stormwater management by government or partnership arrangement is efficient across water sources and water suppliers, such that the optimum value and integrated outcomes are achieved from on-ground measures. This recommendation was developed independently of, but in full agreement with, Recommendation 6 of the recent review of the Water Industry Act (2012).

Suggested initial step(s): As part of the review of Recommendation 1, identify the components of Acts and legislation that need to change, and where secondary impacts may occur when formalising/clarifying any current arrangements, or changes to how stormwater is managed.

It was recognised by the GFP independent panel was not unique but nevertheless worth re-enforcing. A very similar recommendation was developed independently of, but in full agreement with Recommendation 2, namely Recommendation 6 from the recent review of the *Water Industry Act (2012)* by the state government (Government of SA, 2020b):

Recommendation 6 - Investigate options for regulation of drainage services (stormwater management) within the Act, providing an avenue for water industry entities to take

responsibility for part or all of the drainage system, and to cost recover drainage management, maintenance and asset replacement costs through beneficiary pays mechanisms, set through independent pricing regulation.

It is notable also that a review of the Water Industry Act 2012 (SA) was also recommended in the LGA SA's discussion paper on stormwater (LGA SA, 2021a):

“This [LGA SA] paper also outlines recommendations to consider and investigate the opportunities for changes to the Water Industry Act (SA) (2012) (Water Industry Act). This legislation does not currently include stormwater in its definition of ‘water industry’. Therefore, it is largely silent in relation to the management of stormwater. However, with some amendments, it could fundamentally alter how stormwater is governed and managed in South Australia. The Water Industry Act provides the opportunity to appropriately regulate, fund and coordinate the delivery of stormwater services across South Australia similar to how sewerage and drinking water is regulated. The changes that are required are bold and ambitious, and require further consideration to identify any unintended consequences.”

Ongoing discussion post the GFP independent panel, drawing on input from the SRG, identified certain risks that would need to be considered in making changes above in the *Water Industry Act 2012 (SA)*. It was identified that the Act should also be updated to ensure that the economic regulation of investments into improved stormwater management by any private, government or partnership arrangement is efficient across water sources and water suppliers, such that the greatest value and integrated outcomes are achieved from on-ground measures. Noted risks associated with this included that ‘greatest value’ will be difficult to identify given much of the identified value may not be easily quantified (i.e. many benefits are intangible such as public good, improvement in ecological value, reduced heat vulnerability and increased physical activity). Also, while the GFP panel supported pursuit of ‘integrated outcomes’, it was noted that proponents of change be cognisant of ‘scope creep’ on infrastructure projects, and ensuring that investments are sustainable over their full lifecycle.

3.1.3 THE NEED FOR SUSTAINABLE FUNDING

The initial discussion regarding goals for stormwater (Section 3.1.1) and consideration of alternative governance options (Section 3.1.2) by the GFP independent panel also highlighted the overall need to develop a sustainable funding model for stormwater management – either under the current management arrangements or as part of an alternative governance model. The GFP panel discussion led to consensus on Recommendation 3.

Recommendation 3

Undertake detailed assessment of the socio-economic value of improved stormwater management in the current context; implement a targeted communication and engagement program to ensure this value is clearly defined and appreciated throughout the community; and identify and assess sustainable funding options to achieve improvements in stormwater management.

Rationale: The current 'spend' on urban stormwater by local government, state government and other public entities is not clearly quantified, nor are works currently identified in stormwater management plans and asset replacement programs adequately funded. There is a need to identify sustainable funding options to achieve improved stormwater management including drainage, flood mitigation, harvesting and associated measures including greening and ecosystem restoration. These could include a dedicated levy for urban water management, development of offset arrangements based on onsite measures, or a dedicated component of the state budget. Such measures are unlikely to be supported by the community without identifying the current and required spend in detail and the associated savings or service improvements in other areas (such as savings in council rates or the existing Landscape levy that currently contribute significant funding to stormwater management). Identifying key areas of expenditure will also enable an assessment of where public/private partnership or other forms of entrepreneurship can be undertaken to improve the efficiency of stormwater drainage measures, waterway and coastal health improvement and seize opportunities for greening and liveability. Explicit costing is also required for evaluating the funding needs for different stakeholders when considering alternative options of Recommendation 1.

Suggested initial step(s): Seek to identify the current cost of stormwater management by all responsible parties (including local government, state government and developers) and ensure it is reported explicitly (rather than lumped with other measures); this may require resourcing to determine costs and adjustment of current cost reporting to make stormwater more explicit. This cost should be clearly described such that the benefits of adopting changes to management and funding are clearly understood in the community and sufficient funding measures developed with an understanding of the real (full) cost.

It was considered that identifying economic costs is an important step in the transition to Recommendation 1. For example, if assessing the benefits, costs and risks of transferring expenditure on stormwater management from (say) local government to a central entity, there is a need for a clear understanding of the full system costs and the accountabilities pre- and post-transfer in addition to costs associated with the change process itself. A potential limitation of Recommendations 1, 2 and 3 was identified because they do tend to lean toward government authorities, and emphasis on this could exclude consideration of improving stormwater management through partnership with private entities. For example, developers or contractors routinely undertake stormwater management activities as part of their business, subject to state planning laws implemented by local or state government.

Another key concern that was highlighted regarding Recommendation 3 was the uncertainty over what the required spend is today, and what it should be. This was due to the justifiable concern about the absence of a consistent service level requirement for stormwater drainage and flood management, let alone other measures related to urban water management. For example, the acceptable flood drainage level adopted for a given catchment area, even in detailed catchment management assessments like SMPs, is not well defined. Nor is there a clear responsibility to maintain whatever service level is adopted. This uncertainty of service level and responsibility for drainage makes it difficult to assess flood management spend requirements, let alone identify and prioritise how it can be achieved such that implementation can contribute to harvesting, stream flow and ecosystem improvement or seeking urban cooling targets with blue/green opportunities.

Subsequent discussion relating to Recommendation 3 also indicated that there could be more emphasis on assessing the future value of current investment in stormwater and greening measures – for example by

valuing the increased carbon sequestration by restoration of seagrass habitat as per the *Blue Carbon Strategy for South Australia* (Government of SA, 2020a). Additional factors include other well documented benefits to blue/green initiatives including health impacts (e.g. reduced mortality/excess deaths associated with extreme heat events as you increase urban cooling, improved mental health outcomes for those who have regular easy access to high-quality public open blue/green spaces and impacts on property value with proximity to these spaces).

The opportunity to partner with private interests for improved stormwater management was recognised and the independent panel agreed to Recommendation 4, focussing on the opportunity to implement existing targets like those already in state government policy literature like the SA WSUD policy (e.g. Government of SA, 2013) and allowing developers to make contributions to a stormwater management entity for works offsite where it may be beneficial to all concerned.

Recommendation 4

Ensure that the true value of stormwater management is realised and that all new developments have appropriate regard for its value.

Rationale: The independent panel noted that measures for implementing stormwater runoff volume, flow rate reduction or runoff water quality improvement in new developments are not clearly defined in the current state planning and design code. While the code has some tree canopy protection and rainwater harvesting measures, there is an opportunity to implement better outcomes that benefit the developer and the community. One approach identified is to establish a means to enable the development industry to contribute to a fund or scheme to externalise onsite requirements. This could benefit a developer onsite by allowing for greater on-site development density whilst contributing to a fund for water or vegetation management at a priority location nearby (e.g. funding for urban drainage upgrades and maintenance works, greening measures, restoring a degraded stream section, or implementing an 'end of pipe' stormwater quality improvement measure). Drainage or water sensitive urban design projects already recommended by stormwater management plans are suggested to be considered as priority projects, or perhaps other measures developed under Recommendation 5 of this report. This also represents an opportunity for public/private partnership to improve flood control, greening, liveability and wellbeing. The independent panel also discussed the critical need to inhibit ongoing damage to streams via the planning approval process, specifically the cumulative impact of obstructions, infilling and encroachment of structures into riparian zones and drainage lines which represent a major barrier to delivering waterway health outcomes.

Suggested initial step(s): Targets for stormwater runoff volume, flow rate and water quality exist but have not been included throughout the current planning and design code in a consistent way by means of 'deemed to satisfy' provisions; consider including these targets in the planning and design code and investigate a means to establish... an 'offset' arrangement (administered by state or local government) which may be coupled with these more specific targets. If adopting offsets, there is a need to prioritise sites where larger scale stormwater runoff storage, improvement, reuse or ecosystem restoration may be implemented to achieve outcomes at catchment scale.

The GFP independent panel discussion made no firm recommendations on what stipulations would be placed on how the developer contribution in Recommendation 4 could be used, except to note that it could be applied for new measures related to water management, or maintenance of existing measures. This was based on discussion with broad agreement that the maintenance of urban drainage measures, and particularly WSUD systems, is very poor in the absence of a revenue stream (e.g. either income from the project itself when harvesting and selling water, or a dedicated budget for maintenance). This perception is backed by previous research conducted by the Goyder Institute for Water Research with similar findings based on a review of established WSUD systems in Greater Adelaide (Tjandraatmadja et al., 2014). There was

also discussion supporting the concept of achieving greening or other improvement measures via an offset because there are currently high levels of dense urban development being implemented, and a sense that there are 'better wins' available elsewhere in a catchment compared to private urban infill allotments. This should however be considered in the context of cumulative impact at the local scale (i.e. may redevelopments funding blue/green initiatives at a distance from intensive development will not benefit those in the affected area) but this could be addressed through implementing measures like Recommendation 5.

It was noted that there is a need to address the funding requirements of infrastructure in existing developments in addition to new infrastructure, with strong emphasis on the lack of funding available for conventional drainage measures which are approaching end of service life. There was also commentary on the lack of understanding of the associated benefits of improved management such as improved drainage and opportunities for recreation, urban greening environmental quality improvement. The importance of ensuring that appropriate experts consider how this can work within the confines of existing planning legislation was emphasised, while another reference group member noted that careful consideration will need to be given to the question about offsets at different locations throughout the catchment and cumulative impacts of the catchment flow regime – it may take little investment to offset an upper catchment development at the development site, but for a development situated at the end of catchment it may take a disproportionately larger investment to make a difference. This latter point was considered, with commentary during the GFP independent panel session focussing more on an arrangement that would produce equity for all contributors rather than something that would be variable depending on the catchment site.

3.2 Integrated on-ground management options for stormwater

3.2.1 ASSESSING CURRENT PRACTICE

The OG independent panel commenced discussion by considering what has been 'done well' to manage urban water, particularly stormwater, in South Australia to date. The OG independent panel developed the following personal reflections which were recorded as notes on a Mural Board and discussed briefly before proceeding to future needs. Notes have been categorised into themes of on-ground actions and knowledge:

- On-ground actions
 - Adopting passive infiltration measures at various scales, such as localised curb side infiltration and streetscape scale measures in larger public open space
 - Success with larger projects. e.g. Torrens outlet channel improvement, Breakout Creek wetland projects Stages 1, 2 and now 3
 - Implementing the Glenelg-Adelaide Pipeline recycled wastewater distribution scheme
 - Significant levels of wastewater reuse and stormwater reuse – both high when compared to interstate levels
 - Integration of wetlands and managed aquifer recharge (MAR). e.g. Parafield Airport, Oaklands Park
 - Projects 'opening up' stormwater drains e.g. Port Road wetlands
 - Current measures – such as the South Parklands wetlands development
 - SA has four of seven 'World tree cities' currently listed for Australia reflecting interest in greening initiatives⁴

⁴ <https://treecitiesoftheworld.org/directory.cfm>

- Stabilising the water supply to Greater Adelaide by enabling access to the River Murray (key for resilience)
 - Success of the Willunga Basin Water Company as a partnership between government and private sector for water supply services
 - The development of cross-boundary schemes, such as stormwater reuse and the Eastern Regional Alliance.
- Knowledge
 - South Australia has a wealth of experience – a recognised leader in several areas, such as developing and managing MAR Schemes
 - Experience at applying WSUD at the small to large scale, over a long period of time
 - Practitioners have adopted whole of catchment approaches, with focus beyond urban land use
 - There is community advocacy in the urban greening space
 - There has been a coordinated approach in several areas since catchment boards operated in the 1990s.

3.2.2 DEVELOPMENT OF ON-GROUND ACTIONS TO IMPROVE STORMWATER MANAGEMENT

Following the broader discussion regarding successes, the OG independent panel undertook a broad discussion of limitations to urban water management and what on-ground actions could be developed to overcome them. The discussion began by generating ideas for on-ground actions to improve stormwater management. Similar ideas were then collapsed into groups of on-ground actions and then the OG independent panel assigned votes according to their preferred actions as described in Section 2.2. The highest-ranking actions are presented in Table 8.

Table 8. Priority actions identified in the on-ground (OG) independent panel session.

ACTION	VOTES	DESCRIPTION AND SUB-ACTIVITIES
1 Reduce stormwater runoff volume	8	<p>Comprehensive planning to slow down water in landscape to enable greater quantities of water to be treated and harvested, e.g. ‘smart’ rainwater tanks, detention storages in rural/upper catchments, enhanced stream detention systems and infiltration throughout catchments to reduce flow rates and runoff volume, reduce channel and bank erosion, restore natural flows in groundwater and surface water and keep landscape wetter, longer to achieve cooling benefits.</p> <p>OG independent panel commentary included:</p> <ul style="list-style-type: none"> - Identify barriers and facilitate required changes to enable common practice of retention measures. - Focus on concrete channels such as the Sturt River and develop plans to remove concrete and improve/restore an ecosystem. - Need to develop policies and processes to allow industry to help to deliver on the outcomes. - Investigate planning code for gaps and opportunities to build in targets to increase runoff interception. - Specific technologies can be adopted, noting that newer approaches may become apparent over time. Examples of current approaches include using stormwater infiltration systems (e.g. raingarden, kerbside ‘Treenet’ inlets with gravel filed soakage trenches or other technologies) on kerbed roads in urban areas, located 2-20 m upstream of side entry pits. These measures could ideally be coupled with new or existing street vegetation to support greening and evapotranspiration for cooling.

ACTION	VOTES	DESCRIPTION AND SUB-ACTIVITIES
<p>2</p> <p>Understand the source of sediment and other pollutants</p>	<p>6</p>	<p>Understand the source – where is sediment (particularly fine sediment) and nutrient coming from in Adelaide’s urban runoff?</p> <p>OG independent panel commentary included:</p> <ul style="list-style-type: none"> - Engagement with EPA required on current monitoring from key land uses – begin by investigating licensed sites (existing monitoring). - Also require monitoring of specific land uses (unlicensed, diffuse sources) to understand and evaluate the contribution from each source, and then develop targeted solutions. - Channel and bank erosion as a source - how big is this problem? Is it seasonal? Contribution begins with what storm magnitude? What types of erosion occur? Opportunity to use sensors (e.g. stream-based measurements) and study key erosion ‘hotspots’ using UAV/LIDAR?
<p>3</p> <p>Increase vegetation canopy cover</p>	<p>4</p>	<p>Develop a priority map for where cooling measures are required more urgently based on measured heat and vulnerability to heat impacts.</p> <p>OG independent panel commentary included:</p> <ul style="list-style-type: none"> - Greater Adelaide’s 30 year plan (Government of SA, 2017) has tree canopy targets and commitment from SA Government to undertake regular aerial data collection, and to fund the analysis. Need to clarify who is responsible for achieving the targets. - It is understood that most local governments are finding reduced tree cover over last 10 years. Need trees plus water for cooling – and begin in areas where need is highest.
<p>4</p> <p>Understand the effectiveness of treatment measures</p>	<p>3</p>	<p>Better understand the effectiveness of measures to intercept stormwater pollutants to assist with implementation of evidence-based interventions</p> <p>OG independent panel commentary included:</p> <ul style="list-style-type: none"> - Establish pilot developments including performance monitoring which evaluates performance for key pollutant concerns – fine sediment, nutrients and CDOM. - Develop evaluation criteria that enable projects to be assessed, and on which broader implementation can be justified.
<p>5</p> <p>Adequately cost the implementation of stormwater management</p>	<p>3</p>	<p>Implement measures to reward ‘best practice’ and implement a financial measure where stormwater costs are externalised to the broader community.</p> <p>OG independent panel commentary included that:</p> <ul style="list-style-type: none"> - measures could be adopted with this to encourage lot-scale distributed stormwater retention via infiltration or rainwater tanks. For example, this could be achieved via a rebate (from say local government or SA Water) to cover all or part of construction cost – or a development ‘deemed to comply’ framework which would require community/developer education. - If adopting a financial contribution to account for stormwater costs, one based on stormwater discharge estimates will encourage more onsite interventions, noting that a drawback of this is that domestic runoff reduction strategies may compete with municipal schemes for water resources.

ACTION	VOTES	DESCRIPTION AND SUB-ACTIVITIES
6 Linking recycled water schemes	3	<p>There are a number of independently operating recycled stormwater schemes operating in Adelaide where use is limited by the expense of distribution – opportunities exist to link up the current distribution network of approximately 750 km of pipeline to maximise distribution of available resource by market operators.</p> <p>OG independent panel commentary included that:</p> <ul style="list-style-type: none"> - Would need to identify potential routes and their costs to link the existing distribution network - Where possible, purple recycled water distribution pipe could be established <u>now</u> alongside current large-scale roadworks (rather than implement after project completion when works will be more expensive and complex to implement) - Explore opportunities for entrepreneurship in this space – refer to the Willunga Basin Water Company model as a successful case study.
7 Understand vegetation needs	2	<p>Ensure tree species that are planted in the urban landscape are suitable for the environment – for survival, community acceptance and provision of ecosystem benefit.</p> <p>OG independent panel commentary included that:</p> <ul style="list-style-type: none"> - Consider adopting a ‘which plant where’ approach. - Undertake expert opinion/research considering the benefit of native and ornamental vegetation, also accounting for water requirements, work required to clean up leaves in autumn, broader benefit to ecosystem.
8 Quantify the benefits	2	<p>Quantify the benefits of greening to encourage co-investment</p> <p>OG independent panel commentary included that:</p> <ul style="list-style-type: none"> - Adelaide considered amongst leaders in liveable city and water management and there is an opportunity to be a leader in stormwater - Need performance measures and targets and then could adopt an offset scheme for allotment green area for developers – possibly in conjunction with, or in addition to, that suggested for stormwater targets
9 Educate the community	2	<p>Help people understand iconic native species and that we can help them</p> <p>OG independent panel commentary included that there is potential to establish a demonstration or pilot catchment where iconic species are present (or could be present with restoration) such that the community can see – and value - the benefits.</p>
10 Understand infill – current and future trends	2	<p>Develop a spatially explicit understanding of the degree of infill development key opportunities and risks.</p> <p>OG independent panel commentary included that:</p> <ul style="list-style-type: none"> - There are easy wins, including tools to help state and local government to make effective decisions. This could include the findings of urban heat mapping in summer to determine what is effectively greened and what is not, and where (say) irrigation will help to improve greening. Such information could be overlaid with stormwater network models identifying points where diversion or harvesting can contribute. Such a solution can also consider availability of recycled wastewater. - Remote monitoring and policing of systems- smart systems- checking people are doing the right thing

After identifying the most popular on-ground action from the discussion presented in Table 8, a means to achieve this action was subsequently discussed and Recommendation 5 was developed and refined by the

OG independent panel through several iterations of written correspondence. The ultimate recommendation draws on both Actions 1 and 3 from the discussion presented in Table 8.

Recommendation 5

Implement 'smart' integrated 'blue-green' catchment management plans for retaining water in the landscape, preventing and delaying inputs of stormwater into receiving waters and improving their condition.

Rationale: Ongoing development, particularly infill, increases urban population density and the volume and flow rate of runoff to receiving waters, and reduces green space and urban canopy on private land. This recommendation links with Recommendation 4, and recommends planning for improved water resource management, particularly stormwater, to improve wellbeing, liveability and biodiversity. While stormwater management plans developed by local government already exist to manage flooding, runoff volume and quality in a catchment, there is a need for planning to adopt greening, increased canopy cover targets using appropriate species and liveability measures. Spatially explicit regional planning could include prioritising where targeted stormwater interception, detention or infiltration measures could be located to efficiently improve streamflow regimes to downstream ecosystems and consider opportunities to harvest water to support developing and maintaining canopy cover or other green space. It should also prioritise where opportunities exist for protecting and restoring existing urban streams, for example, by converting existing drains to more natural systems and allowing the community to access these new blue/green spaces. The production of these blue-green plans should be based on input from both technical and social investigations, including seeking guidance from indigenous perspectives.

Suggested initial step(s): Identify and pilot a blue-green 'liveability improvement plan' for a demonstration suburb/subcatchment, identifying and prioritising opportunities for improved water management to occur that is coupled with opportunities for greening (supported where necessary by water harvesting) and ecosystem restoration of stream or drainage sites where access is possible. This should be supported with monitoring and evaluation to ensure that the longer-term benefits are achieved (see Recommendation 7).

Follow up discussion with the OG and GFP independent panel around Recommendation 5 indicated that case studies exist which could form a basis for future planning, such as that conducted by the CRC for Water Sensitive Cities for projected future infill options in Salisbury East (Renouf et al., 2020). In this case study, the authors presented an application of an 'Infill Performance Evaluation Framework' to understand water related and urban heat impacts of infill in the study region, and demonstrated how WSUD typologies, building design requirements and alternate water service arrangements could improve the performance of the area in terms of liveability, water security and resilience. In this case study, input was sourced from a project team collaborating with urban planners and water practitioners, with other stakeholders including Housing SA and Water Sensitive SA. The OG and GFP independent panel discussion around this point also included a need to consider input from the local communities affected by blue-green planning, including effort to seek guidance from indigenous perspectives on the management of water in the area.

The OG independent panel also indicated a need to consider appropriate species as ecological restoration and greening initiatives were undertaken. For example, the benefits of restoring landscape with native species that have value to the local ecology as opposed to lower value vegetation with benefits more limited to canopy cover.

It was noted that transitioning to blue-green infrastructure is important and achieves good community outcomes, however the overarching importance of urban drainage needs must be considered. It was also

noted that the full lifecycle costs should be considered as maintenance requirements may increase when implementing more 'natural' approaches to urban drainage. The recommendation also links neatly with the current works of Green Adelaide and DEW in the area of catchment greening – for example, the *Green Adelaide Regional Landscape Plan 2021-2026* (Green Adelaide, 2021, p.16) has a goal to “Increase the extent and quality of urban green cover” and three key focus areas which align closely with this recommendation.

It is notable that current projects being undertaken by Green Adelaide on the River Torrens demonstrate the kind of works that could be recommended for a catchment using a plan in accordance with Recommendation 5. These include the restoration of Breakout Creek from a more artificial urban channel to a more natural creek environment⁵, and the efforts to restore the channel and associated ecosystem at priority sites in partnership with eight local governments⁶. Efforts to restore aquatic ecosystems and re-establishing their potential to store atmospheric carbon are another example of potential recommendations of a blue-green catchment plan, in line with the *Blue Carbon Strategy for South Australia* (Government of SA, 2020a).

For the initial steps to achieve Recommendation 5, it should be noted that there are several sources of recommended locations for larger scale stormwater harvesting, such as the *Urban Stormwater Harvesting Options Study* (Wallbridge and Gilbert, 2009), in addition to numerous recommendations for improved stormwater drainage, runoff volume and runoff quality improvement in approved SMPs. In addition, studies of stream bank and channel condition could be referred to or expanded to identify areas of greatest need for investment both in terms of the level of degradation and the potential to improve the overall ecosystem. Finally, the output of Recommendation 5 could also be used as a basis for prioritising the use of offset funds.

During ongoing written correspondence after the OG independent panel session, the popularity of Action 6 in Table 8, namely the opportunity to link up existing recycled stormwater infrastructure in the Greater Adelaide region, was emphasised further. Discussion related to this measure led to the development of Recommendation 6, which was also refined through written correspondence with the OG independent panel. The popularity of this measure was justified because it was considered 'low hanging fruit' to improve the capability of existing water recycling schemes to collect and distribute more water. It also requires urgent action to take advantage of the potential to link up schemes at minimal cost if pipeline construction could be conducted as part of the current program of scheduled transport corridor development works in Greater Adelaide, for example the Torrens to Darlington Project completing the North-South Corridor, and the Fleurieu Connections project, involving road duplication works on Main South Road and Victor Harbour Road.

⁵ See project overview here: <https://www.greenadelaide.sa.gov.au/projects/breakout-creek-stage-3>

⁶ See project overview here: <https://www.greenadelaide.sa.gov.au/projects/river-torrens-recovery-project>

Recommendation 6

Establish a connected and integrated harvesting and reuse scheme across Adelaide.

Rationale: At present there are several recycled stormwater schemes fed with stormwater or treated wastewater operating in metropolitan Adelaide. It is known that the current water recycling schemes are capable of collecting and delivering greater volumes of harvested runoff to users but this is impeded by the high cost of distribution pipelines to access new customers. This may be addressed by linking up currently separate 'third pipe' distribution and aging potable water infrastructure (while addressing all cross-connection risks) for the mutual benefit of scheme operators and the community. Linking schemes was suggested to improve the resilience of supply and provide a mains distribution that can be accessed by currently inaccessible points of demand, like industrial users and public open space. The potential for linking existing schemes to make the most of existing investment in alternative water infrastructure has been proposed only at the conceptual level and would need to meet a range of criteria, including economic merit. However, it was considered a high priority activity by the panel particularly while other infrastructure – such as transport corridors – are under design and construction which may enable the evolution of pipeline networks to occur more efficiently.

Suggested initial step(s): A conceptual assessment of what level of linkage between water supply authorities (e.g. SA Water, Salisbury Water and/or other local councils and private water harvesting and reuse systems) is both economically and institutionally beneficial, with consideration of large-scale transport corridor upgrades where construction costs can be leveraged.

A parallel benefit of Recommendation 6 noted by the independent panel was that there are concerns regarding the level of salinity in recycled wastewater and the opportunity to mix both stormwater and wastewater goes some way to resolve this concern through mixing (colloquially termed 'shandyng') higher salinity recycled wastewater with typically lower salinity stormwater. Mixing these sources has been undertaken in the past – recycled wastewater was mixed with recycled stormwater to provide the 'third pipe' supply into Mawson Lakes until this changed to a recycled wastewater supply only.

It should be noted that the idea behind Recommendation 6 was based on initial discussions and presentation material made available by Greg Ingleton (Cool by Nature Pty Ltd.), of which some OG panel members were aware. A properly considered master planning approach to this task would be important before support from all stakeholders could be achieved. This was because it was perceived that some schemes may not be suitable for connecting to a single 'super' scheme, and that integration to one scheme may require increased risk management by individual contributors to avoid compromising all suppliers and customers of a more connected recycle water supply scheme.

It was also noted that this was consistent with an LGA SA discussion paper seeking to improve stormwater management arrangements (LGA SA, 2021a), with the need for new greenfield development to explore opportunities to link up to existing schemes, especially if a more 'connected', centrally managed scheme is achieved.

Recommendation 7 was developed based on actions 2 and 4 identified in Table 8. The OG panel were aware of existing review and reporting related to these measures, from the Adelaide Coastal Waters Study findings (Fox et al., 2007) through to recent data collation and review activities undertaken by the Goyder Institute for Water Research (Myers et al., 2021).

Recommendation 7

Establish a research, monitoring and performance evaluation program to identify the on-ground actions required to increase urban greening/vegetation and limit the export of runoff and fine sediments to Adelaide's coastline, including investigation of the land use sources of fine sediments and the effectiveness of different treatment options being applied.

Rationale: A key driver for improved stormwater management is improving the quality of streams and coastal waters. It is well established that fine sediment and nutrients are the main causes of coastal water quality and seagrass decline. However, the key sources of fine sediment and nutrients are currently not well defined. There is little data available locally linking runoff water quality to land uses. Data on the extent of stream bank and channel degradation and how it contributes to fine sediment loads is limited. Data is also limited regarding the ability of common measures to improve urban runoff quantity and quality (e.g. bioretention, or street sweeping) or measures to restore stream bank and channel systems (such as armouring or runoff detention). Related to this, there is limited data about the performance of catchment greening approaches, such as what vegetation is most effective and/or most acceptable to the public, and where, or how common vegetation options perform when coupled with opportunistic stormwater infiltration measures. These are critical knowledge gaps that inhibit confidence in the effectiveness of investments into stormwater management and without improved understanding of critical sediment point sources and effective treatment options, will likely lead to ill-targeted investment and outcomes.

Suggested initial step(s): Establish a research program that addresses urban water management knowledge needs in the urban water space with a strong emphasis on monitoring runoff quality from key land uses contributing to local streams, and the rate of degradation in local streams. This could begin with mapping locations of high risk based on topography, soil type, flow rates and rainfall intensity. In conjunction, there is a need for evaluating the performance of commonly applied water quality improvement measures (such as bioretention and street sweeping regimes) and measures for protecting stream banks and channels. It is also important to evaluate the success of passive harvest and irrigation measures, such as infiltration systems and quantify the extent of their beneficial (or otherwise) relationship with vegetation, and the contribution of vegetation to the ecosystem.

Further discussion on Recommendation 7 by the OG panel was limited, however interested readers are directed to the background material to this recommendation (Myers et al., 2021) which contains a comprehensive literature review of local knowledge on catchment pollutant sources specific to land use, and the performance of common water quality improvement measures with potential for targeting pollutants including fine sediment. While local knowledge of sources was indeed limited, current knowledge of high and low risk factors for sediment generation and transport could be applied to produce a conceptual risk map of where sediment may be derived (based on, say, topography, frequency and magnitude of flows, soil type and rainfall intensity. It was also noted that previous research by the Goyder Institute for Water Research (Rouse et al., 2016) has identified infrequent high flow events to be the a large source of sediment transport in major stream channels, and this being the case, that interventions need to be considered that are appropriate for high peak flows.

Recommendation 8 was developed based on the popularity of actions 5 and 10 from Table 8, and broader discussion related to the perceived lack of on-ground surveillance and education activity targeting the development industry, particularly as urban infill development continues in existing urbanised catchments.

Recommendation 8

Establish a robust monitoring and compliance program in new and existing developments, with a particular focus on identifying water quality impacts on receiving waters.

Rationale: The independent panel perceived that the amount of active catchment surveillance has reduced over time, and there is limited ability for authorities, such as local government and the SA Environment Protection Authority, to evaluate the effectiveness of water quality improvement measures. A key focus of this was examining sediment controls at development sites across metropolitan Adelaide and undertaking work with the construction industry to improve it. Other measures of concern included those noted with Recommendation 4, where the cumulative impact of obstructions, filling and encroachment of structures into riparian zones of urban streams and drainage lines creates a major barrier to waterway health outcomes.

Suggested initial step(s): Re-establish active surveillance via public or environmental health officers targeting water quality improvement measures, including small- and large-scale development sites where on-site environmental management does not already include monitoring and reporting of runoff. It was recommended that this process begin as a learning partnership with industry to educate and improve practice, rather than a means to immediately 'punish' poor practice.

The OG independent panel noted a need to be very clear of the objectives, and that proactive investigations such as a catchment risk assessment would go a long way to managing some risks. A catchment risk assessment tool was developed by the Goyder Institute for Water Research which could form the basis of catchment risk assessment, and also be refined as new knowledge is developed (Myers et al., 2021). There was also feedback about the need to consult with environmental health officers or other roles (such as nuisance officers) on their preparedness to meet this new need, both in terms of time and equipment. The OG panel discussion was however weighted to the need to resource this work being undertaken, not seeking to force a greater workload where it cannot be reasonably undertaken by existing personnel.

4 Concluding Remarks

The GFP and OG independent panels of researchers have produced eight broader recommendations which were considered beneficial to improving the management of urban water, particularly stormwater in South Australian and in particular Adelaide. It is intended that the recommendations of the independent panel will be available to each of the stakeholder organisations and groups. It is also intended that these organisations consider and ultimately prioritise actions provided in the 'initial steps' supporting each recommendation with an overarching goal to contribute to a collaborative and unified outcome for addressing stormwater issues and opportunities. The recommendations from the independent panel are intended to contribute to and inform the current a stormwater expert panel, which includes executive level expertise from local government. This stormwater expert panel has been established by DEW to determine clear responsibility for private local, public local and regional drainage.

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Appendix A – Independent Panel Workshop Agenda

The agenda of the independent panel workshop into governance of urban water, particularly stormwater, was as follows.

Goyder Institute independent panel project: Governance, funding and policy arrangements to improve urban water management in Greater Adelaide

Workshop No.3: 9:00am - 12:00pm, Tuesday 8 February 2022

MS Teams video-conferencing

Attendees:

Baden Myers (UniSA)
 Chris Chesterfield (Monash)
 Lin Crase (UniSA)
 Melissa Jane Nursey-Bray (Adelaide University)
 Tim Muster (CSIRO)
 Melissa Bradley (Water Sensitive SA)
 Bruce Naumann (City of Salisbury)

Goyder Institute: Kane Aldridge, Daniel Pierce
Workshop facilitator: Rachel Barratt (Jacobs)

Workshop purpose

- To discuss and identify possible future governance and models (options) for stormwater and urban waterway governance, funding and policy arrangements in Adelaide
- To identify preferred governance and funding models
- To inform a paper for DEW provide advice about options and pathways or recommendations for next steps

AGENDA

Item	Description	Timing	Responsibility
1.	Welcome & introduction	9.10 to 9.30 am	KA, RB
2.	Presentation <i>Presentation outlining the key findings from the synthesis of stormwater & urban waterways governance models</i>	9.30-10.20am	CC
	BREAK	10.20-10.30am	All
	How to use mural - Quick tour of the mural board and how to use it fo the next sessions	5 min	RB
3	Identify and confirm options	10.35-11.00 am	RB
4	Assessment Criteria/ Principles	11.00-11.20 am	RB
5	Initial assessment of options	11.20-11.50 am	RB
6	Knowledge gaps and next steps	11.50-12.00 pm	BM
9	Meeting close	12.15pm	RB

The agenda of the independent panel workshop into options for on-ground actions to improve urban water management was as follows.

Goyder Institute independent panel project: On-ground actions to improve urban water management in Greater Adelaide

Workshop No.3: 9:30am - 12:30pm, Wednesday 30th March

MS Teams video-conferencing

Attendees:

Baden Myers (UniSA)
 Faisal Ahammed (UniSA)
 Howard Fallowfield (Flinders University)
 Huade Guan (Flinders University)
 Melissa Bradley (Water Sensitive SA)
 Margaret Shanafield (Flinders University)
 Martin Lambert (University of Adelaide)
 Tanya Doody (CSIRO)
 Tim Muster (CSIRO)

Goyder Institute: Kane Aldridge, Daniel Pierce
Workshop facilitator: Rachel Barratt (Jacobs)

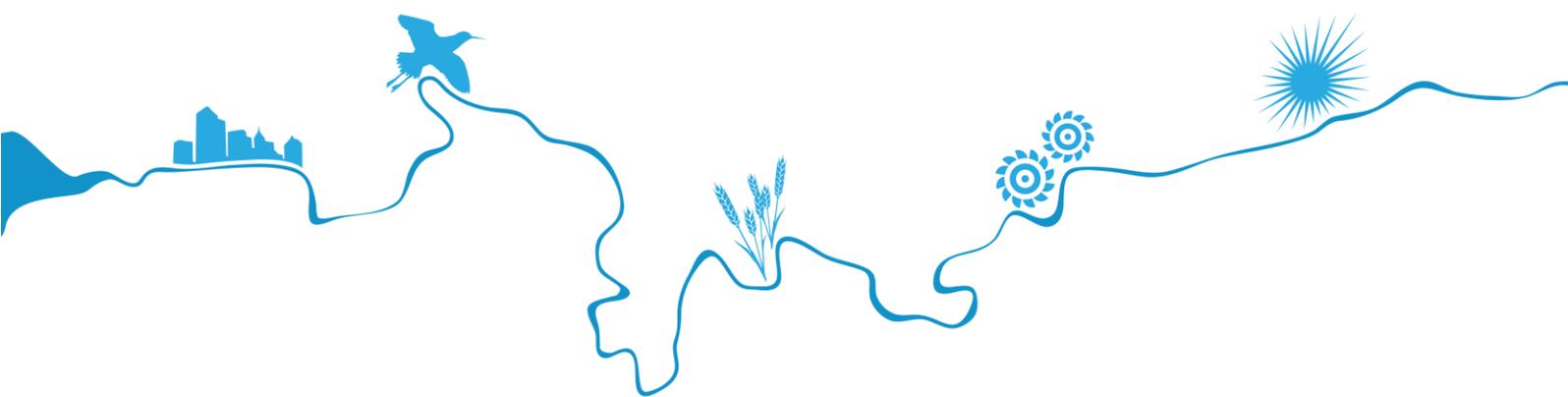
Workshop purpose

- To discuss and identify priority actions for urban water (stormwater and wastewater management) that will contribute to:
 - Urban cooling benefits
 - Stream management and protection benefits
 - Coastal and marine benefits
- To inform a paper for provide advice or recommendations to the SA Government for next steps

AGENDA

Item	Description	Timing	Responsibility
3.	Welcome & introductions <ul style="list-style-type: none"> • Kane/Daniel <ul style="list-style-type: none"> ○ Welcome participants ○ Acknowledgement of Country ○ Brief overview of project scope and outcomes ○ Summary of previous work • Rachel <ul style="list-style-type: none"> ○ Run through agenda ○ Reminder of what was discussed in workshop in November ○ Water Security Statement recommendations 	20 minutes 9.30am	KA, RB
4.	Presentation – scene setting <i>Baden to present the key findings and messages in the draft paper.</i> General discussion with the group regarding the paper, clarifications etc <ul style="list-style-type: none"> • 15 minute presentation • 15 minute discussion 	30 minutes 9.50-10.20am	BM
	SHORT BREAK	10.20-10.25am	All

	How to use mural	5 min	
3	<p>Identify and confirm possible actions</p> <p>Q. What further on-ground work is needed to progress urban water management (stormwater and wastewater) to achieve the following outcomes/benefits:</p> <ul style="list-style-type: none"> - Urban cooling and improved liveability - Protection and management of streams and associated environs - Protection and management of coastal and marine environments <p>Using the Mural Board™ the group will add to the actions already identified by the paper</p>	30 min 10.35-11.05am	RB
4	<p>Prioritisation</p> <p>Q. How do we prioritise actions?</p> <p>Using the Mural Board™ as a group we consider how best to prioritise actions</p>	30 minutes 11.05-11.35am	RB
	SHORT BREAK	5 minutes	All
5	<p>Voting</p> <p>Q. What actions do you think are the most urgent and important?</p> <p>The group will vote on the actions – using Mural Board™ can pick top 3-4 actions</p>	15 minutes 11.40-12.00	RB
6	<p>Knowledge Gaps and Next Steps</p> <p>Open discussion regarding the next steps, input into the paper</p>	15 min 12.00-12.15pm	BM
9	Meeting close	12.15pm	RB



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