Government of **Western Australia**
Department of **Water and Environmental Regulation**

Stormwater management manual for Western Australia

Chapter 1 Introduction

Department of Water and Environmental Regulation

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Disclaimer

Preface

Stormwater is water flowing over ground or built-up surfaces and in natural streams and drains, as a direct result of rainfall over a catchment (ARMCANZ and ANZECC 2000). Stormwater consists of rainfall runoff and any material (soluble or insoluble) mobilised in its path of flow. Stormwater management examines how the runoff quantity, and these pollutants, can best be managed from source to the receiving water bodies using the range of management practices available.

In Western Australia (WA), where there is a superficial aquifer, drainage channels can commonly include both stormwater from surface runoff and groundwater that has been deliberately intercepted by drains installed to manage seasonal peak groundwater levels. Stormwater management is unique in WA as both stormwater and groundwater may need to be managed concurrently.

Rainwater has the potential to recharge the superficial aquifer, either before runoff commences or throughout the runoff's journey in the catchment. Urban stormwater on the Swan Coastal Plain is an important source of recharge to shallow groundwater, which supports consumptive use and groundwater-dependent ecosystems.

With urban, commercial or industrial development, the area of impervious surfaces within a catchment can increase dramatically. Densely developed inner-urban areas are almost completely impervious, which means less infiltration, the potential for more local runoff and a greater risk of pollution. Loss of vegetation also reduces the amount of rainfall leaving the system through the evapotranspiration process. Traditional drainage systems have been designed to minimise local flooding by providing quick conveyance for runoff to waterways or basins. However, this almost invariably has negative environmental effects.

This manual presents a comprehensive approach to management of stormwater in WA, based on the principle that stormwater is a resource – with social, environmental and economic opportunities. The community's current environmental awareness and water restrictions are influencing a change from stormwater being seen as a waste product with a cost, to a resource with a value. Stormwater management aims to build on the traditional objective of local flood protection by having multiple outcomes, including improved water quality management, protecting ecosystems and providing liveable and attractive communities.

This manual provides coordinated guidance to developers, environmental consultants, environmental and community groups, industry, local and state government, water service providers and other agencies on current best management principles for stormwater management.

It is intended that the manual will undergo continuous development and review. As part of this process, any feedback on the series is welcomed and may be directed to the Urban Water Branch of the Department of Water and Environment Regulation, at urbanwater.enquiry@dwer.wa.gov.au

Western Australia stormwater management objectives

Water quality
To maintain or improve the surface and groundwater quality within the development areas relative to pre-development conditions.

Water quantity
To maintain the total water cycle balance within development areas relative to the pre-development conditions.

Water conservation
To maximise the reuse of stormwater.

Ecosystem health
To retain natural drainage systems and protect ecosystem health.

Economic viability
To implement stormwater management systems that are economically viable in the long-term.

Public health
To minimise the public risk, including risk of injury or loss of life, to the community.

Protection of property
To protect the built environment from flooding and waterlogging.

Social values
To ensure that social, aesthetic and cultural values are recognised and maintained when managing stormwater.

Development
To ensure the delivery of best practice stormwater management through planning and development of high-quality developed areas in accordance with sustainability and precautionary principles.

Western Australia stormwater management principles

- Incorporate water resource issues as early as possible in the land use planning process.
- Address water resource issues at the catchment and sub-catchment level.
- Ensure stormwater management is part of total water cycle and natural resource management.
- Define stormwater quality management objectives in relation to the sustainability of the receiving environment.
- Determine stormwater management objectives through adequate and appropriate community consultation and involvement.
- Ensure stormwater management planning is precautionary, recognises inter-generational equity, conservation of biodiversity and ecological integrity.
- Recognise stormwater as a valuable resource and ensure its protection, conservation and reuse.
- Recognise the need for site-specific solutions and implement appropriate non-structural and structural solutions.

Contents

Summary

This chapter outlines the purpose of the Stormwater management manual for Western Australia. Stormwater is water flowing over ground or built-up surfaces and in natural streams and drains, as a direct result of rainfall over a catchment (modified from ARMCANZ and ANZECC, 2000). Normal rainfall events on natural or undeveloped catchments are generally infiltrated or absorbed into the ground, with some excess slowly forming overland runoff to streams or watercourses.

In catchments with built environments such as urban, rural residential, commercial and industrial development, rainfall rapidly collects on impervious surfaces. The impervious surfaces of the built environment, including streets, parking areas, paved areas and rooftops, prevent absorption of water into the ground. Stormwater consists of rainfall runoff and any material (soluble or insoluble) mobilised in its path of flow. Stormwater management examines how the runoff quantity and these pollutants can best be managed from source to the receiving water bodies using the range of better management practices available. The quality and quantity of stormwater shed by a built area is dependent on the climate, geology, topography, land use, degree of imperviousness and stormwater management practices.

Stormwater management incorporates the efforts to address the negative effects of inadequate and/or inappropriate stormwater management on the environment and the community. It aims to build on the traditional objective of local flood protection by having multiple outcomes, including improved water quality management, valuing stormwater as a resource, protecting ecosystems and providing liveable and attractive communities.

The manual's purpose is to provide a consistent approach while considering a variety of stormwater management options that may be suitable to a range of built environments across WA. Sections of the manual are also relevant to individual landowners and community groups. Information in the manual is generic and needs to be adapted to suit particular sites and circumstances. It is recommended that you use this guide after identifying and considering any individual circumstances that apply to the catchment, redevelopment or development area. Stormwater management techniques should not be implemented in isolation, but as part of an overall management plan.

1 What is stormwater?

Stormwater is water flowing over ground or built-up surfaces and in natural streams and drains, as a direct result of rainfall over a catchment (ARMCANZ and ANZECC 2000).

Normal rainfall events on natural or undeveloped catchments are generally infiltrated or absorbed into the ground, with some excess slowly forming overland runoff to streams or watercourses. The impervious surfaces of the built environment, urban, rural residential, commercial and industrial development prevent absorption of water into the ground. In these catchments, surfaces such as roads, parking areas, paved areas and rooftops mean that rainfall rapidly collects on impervious surfaces and is unable to replenish the superficial groundwater aquifer to the degree of the undeveloped catchment.

Rainwater has the potential to recharge the superficial aquifer either before runoff commences or throughout the runoff's journey in the catchment. Urban stormwater on the Swan Coastal Plain is an important source of recharge to shallow groundwater which supports consumptive use and groundwater-dependent ecosystems.

Groundwater is very close to the surface over much of the Perth metropolitan area and in other areas of WA. To enable development and prevent seasonal inundation when groundwater levels peak in winter, drains have been traditionally installed to intercept and manage the seasonal peak groundwater levels. In these areas, stormwater and groundwater management are inseparable and need to be managed concurrently.

Stormwater consists of rainfall runoff and any material (soluble or insoluble) mobilised in its path of flow. The quality and quantity of stormwater shed by a built area is dependent on the climate, geology, topography, land use, degree of imperviousness and stormwater management practices. In most established urban areas, stormwater enters the waterways without treatment; however, in some cases the polluted stormwater may be treated through structural measures such as swales, traps and basins. If stormwater is not infiltrated close to where it falls, there is the potential to collect contaminants and litter from hard surfaces such as roads, roofs, pathways and buildings before it enters waterways.

These contaminants and the increased flows that may occur can impact the receiving environment if not adequately managed, causing erosion, nutrient enrichment, pollutant contamination and changes to watercourses. Communities may also be affected with nuisance algal blooms, increased mosquitoes and midge populations and a reduction in aesthetic values. The degree of stormwater pollution will depend on the nature of the catchment and the stormwater management measures that have been implemented. Stormwater management examines how these pollutants can best be managed from source to the receiving water bodies using the range of management practices available.

Traditionally, stormwater was generally piped and channelled into retention basins, watercourses or drains that discharge into natural waterways, wetlands, beaches or bushland. It was believed that all rainfall events posed a flooding risk because of the degree of imperviousness of the built environment. However, normal rainfall events can be adequately dealt with on site in most areas, through infiltration or water capture and reuse. Only high-intensity rainfall events need to be managed primarily for water quantity.

Stormwater management addresses the negative effects of inadequate and/or inappropriate stormwater management practices on the environment and the communities. It aims to build on the traditional objective of local flood protection by having multiple outcomes, including improved water quality management, valuing stormwater as a resource, protecting ecosystems and providing healthy attractive communities.

2 What is the purpose of this manual?

The manual's purpose is to provide a consistent approach to a variety of stormwater management options that may be suitable to a range of built environments throughout WA. The overarching stormwater management objective embraces the principle of sustainability, to achieve a balance of economic, social and environmental outcomes through policy, planning and development.

The manual is directed at the management of stormwater in new developments and redevelopment projects, as well as the retrofitting of existing drainage systems.

The following information is included:

- Reasons why we need to manage stormwater.
- Performance objectives for managing stormwater.
- Preparing and implementing water management strategies, plans and reports (e.g. stormwater management strategies and plans, drainage management strategies and plans, groundwater management strategies and plans).
- Maximising the adoption of source controls.
- Non-structural and structural management tools available.
- Retrofitting existing urban and built areas, in addition to management of new development areas.
- Capture and reuse of stormwater.
- Engaging the community for optimal results.
- Performance monitoring and evaluation.

This manual supersedes *Manual for managing urban stormwater quality in Western Australia* (Water and Rivers Commission 1998). It considers:

- experience and knowledge gained in respect to the management systems implemented in WA and their maintenance requirements
- the change in emphasis from end-of-pipe solutions to at-source management, including pollution prevention, planning mechanisms, regulation and education
- draft *State planning policy 2.9: Planning for Water* and the associated guidelines (WAPC 2022) and an increasing need for implementing water sensitive urban design principles and approaches in planning and development
- *Australian runoff quality guidelines* (Engineers Australia 2006)
- the increasing emphasis, in Australia and overseas, to address the health of aquatic ecosystems including streams, rivers and wetlands; improved environmental performance is needed to ensure that the environmental values and beneficial uses of receiving waters are sustained or enhanced
- the need for current information on 'at source' non-structural controls, retrofitting to improve the effectiveness of existing drainage infrastructure, information data sheets on new products, and guidelines on the monitoring of the performance of stormwater management systems

- application of current best practice approaches and criteria for small rainfall event management in WA, including strengthening the case for small rainfall event management to be considered early in the design of urban stormwater management systems
- management of high groundwater at the beginning of the stormwater management decision process
- new rainfall event terminologies from the Australian Government's review of *Australian rainfall and runoff: a guide to flood estimation* (2019)
- natural hydrological processes in stormwater management systems designs
- urban liveability and amenity in the design of stormwater and high groundwater management systems
- updated information on stormwater management in the land and water planning process.

The strategy outlined in this manual is in accordance with current best practice in stormwater management and with 'whole of catchment' and 'total water cycle management' approaches (refer to Chapter 2).

3 Who is this manual for?

This manual has been developed for engineers, planners, environmental officers, natural resource management officers, scientists and managers working in local government and State Government, the development industry, environmental and planning consultants, water service providers and water resource managers. Sections of the manual are also relevant to individual landowners and community groups.

The three main groups responsible for environmental stormwater management are the development industry, local government and State Government.

4 How can it help me?

Increasingly, we are faced with the need to meet multiple outcomes when considering stormwater in the built environment. This manual provides practical advice on planning for, implementing and assessing the success of stormwater management initiatives.

The manual particularly highlights the importance of considering stormwater at the earliest possible planning stages, it outlines successful approaches, case studies and discusses proven planning approaches. There is a particular emphasis on source controls through planning mechanisms, regulation and education. Included are specific design guidelines for structural controls that can be useful close to the source of the stormwater as well as further down the catchment.

Local government will find this manual useful to:

- understand key stormwater management concepts
- acknowledge stormwater values and the benefits of protecting these values
- plan for new development and assess development applications
- give improved certainty in decision-making affecting stormwater issues
- ensure the inclusion of stormwater management principles in local or district structure planning, local planning strategies and schemes and their amendments
- integrate stormwater planning with strategic planning

- develop and assess water management strategies, plans and reports (e.g. stormwater management strategies and plans, drainage management strategies and plans, groundwater management strategies and plans)
- plan and design new stormwater management infrastructure
- help identify opportunities to improve environmental performance of all stormwater management infrastructure
- instigate innovative use of public open space that meets social and environmental outcomes for stormwater management
- save time and money when preparing water management strategies, plans and reports (e.g. stormwater management strategies and plans, drainage management strategies and plans, groundwater management strategies and plans) work to ensure that operational activities are consistent with stormwater management principles
- assist in developing practical programs aimed at increasing community understanding and awareness
- recommend stormwater management approaches that require less maintenance, time and money
- guide retrofitting and catchment improvement projects.

Development industry will find this manual useful to:

- understand key stormwater management concepts
- acknowledge stormwater values and the benefits of protecting these values
- give improved certainty in decision-making affecting stormwater issues
- save time and money when preparing, water management strategies, plans and reports (e.g. stormwater management strategies and plans, drainage management strategies and plans, groundwater management strategies and plans) and outline development plans
- plan and design new developments and stormwater management infrastructure
- assist with innovative solutions for meeting stormwater management and outline development plans
- provide stormwater management approaches which will reduce construction costs
- standardise the quality of implementation for new and redevelopments.

State Government, decision-making authorities and water service providers will find this manual useful to:

- understand key stormwater management principles, objectives, strategies and concepts
- acknowledge stormwater values and the benefits of protecting these values
- plan for conservation, enhancement and appropriate development
- protect wetlands, waterways and water supplies through promoting adoption of best management practice principles for stormwater management in land use planning and management
- set conditions
- prepare standards, guidelines and policies to protect water resources
- provide advice and information on management of stormwater to stakeholders
- assess the performance of stormwater management approaches
- assess statutory planning documentation at the regional and local scale and stormwater management audits

- ensure inclusion of water sensitive urban design principles in strategic guidelines, structure plans, outline development plans, rezoning applications and subdivision plans
- plan community education campaigns.

Landowners, individuals and community groups will find this manual useful to:

- understand key stormwater management concepts
- acknowledge stormwater values and the benefits of protecting these values
- assist in implementing best practice for water management, including water capture and reuse, and minimising stormwater pollution
- purchase property with an improved awareness of best management practices for stormwater management
- contribute to planning and implementation of local stormwater management plans
- guide 'on-catchment' improvement projects that involve local stormwater management.

5 How is it presented?

The manual comprises a suite of guiding papers that are relevant to the management of stormwater, in accordance with best management practice. The standalone chapters allow for ease of reference, handling and updating.

1 Introduction	Outlines the purpose of the manual, its intended audience and benefits.
2 Understanding the context	Describes the reasons for improving stormwater management and provides the principles, objectives, key roles and responsibilities for stormwater management in WA.
3 Best planning practice for stormwater management *(Remarks: Superseded by Better Urban Water Management Guideline (WAPC 2008 or Planning for Water Guideline 2022)).*	Provides references to documents that contain information about how stormwater management planning can be incorporated within the current land and water planning framework.
4 Integrating stormwater management, including *Decision process for stormwater management in Western Australia*	The approaches of 'integrating stormwater management' were developed as part of the department's urban water capacity building project. The *Decision process for stormwater management in Western Australia* (DWER 2017) is a part of this chapter that supports decision-making by urban planners, local governments, state agencies, catchment management bodies and drainage service providers for management of stormwater.
5 Stormwater management plans	Provides guidelines on the preparation of stormwater management plans for specific development and whole of catchment-scale projects.
6 Retrofitting	Explains issues to be addressed and presents structural tools for improving stormwater management in existing urban developments

	through modification of existing stormwater systems, or installation of additional/alternative stormwater management devices and approaches. Includes case studies and examples that demonstrate how to undertake retrofitting projects.
7 Non-structural controls	Describes the initiatives available to manage the quantity and reduce pollution of stormwater by optimising practices of local council operations, construction companies and householders, through mechanisms such as council regulation, community education and participation.
8 Education and awareness for stormwater management	Presents ways to prepare and deliver education programs to reduce stormwater pollution from household and business activities.
9 Structural controls	Describes structural measures that can be designed and located in a catchment undergoing new development or retrofitted within an existing development to manage the quantity of stormwater runoff and prevent or treat stormwater pollution.
10 Performance monitoring & evaluation	Provides information on establishing a monitoring and evaluation program that tracks the trends and performance of structural and non-structural stormwater management practices.
11 Further information	Provides a glossary of terms used in the manual and some useful contacts, websites and references for obtaining further information about stormwater management.

6 How to use this manual

Information in the manual is generic and needs to be adapted to suit particular sites and circumstances. It is recommended that you use this guide after having carefully considered the circumstances prevailing within the applicable catchment, redevelopment or development area. Stormwater management techniques should not be implemented in isolation, but as part of an overall management plan (Figure 1). A checklist of issues to consider when developing stormwater management plans and strategies and a decision-making process for the selection of best management practices are outlined in Chapter 5.

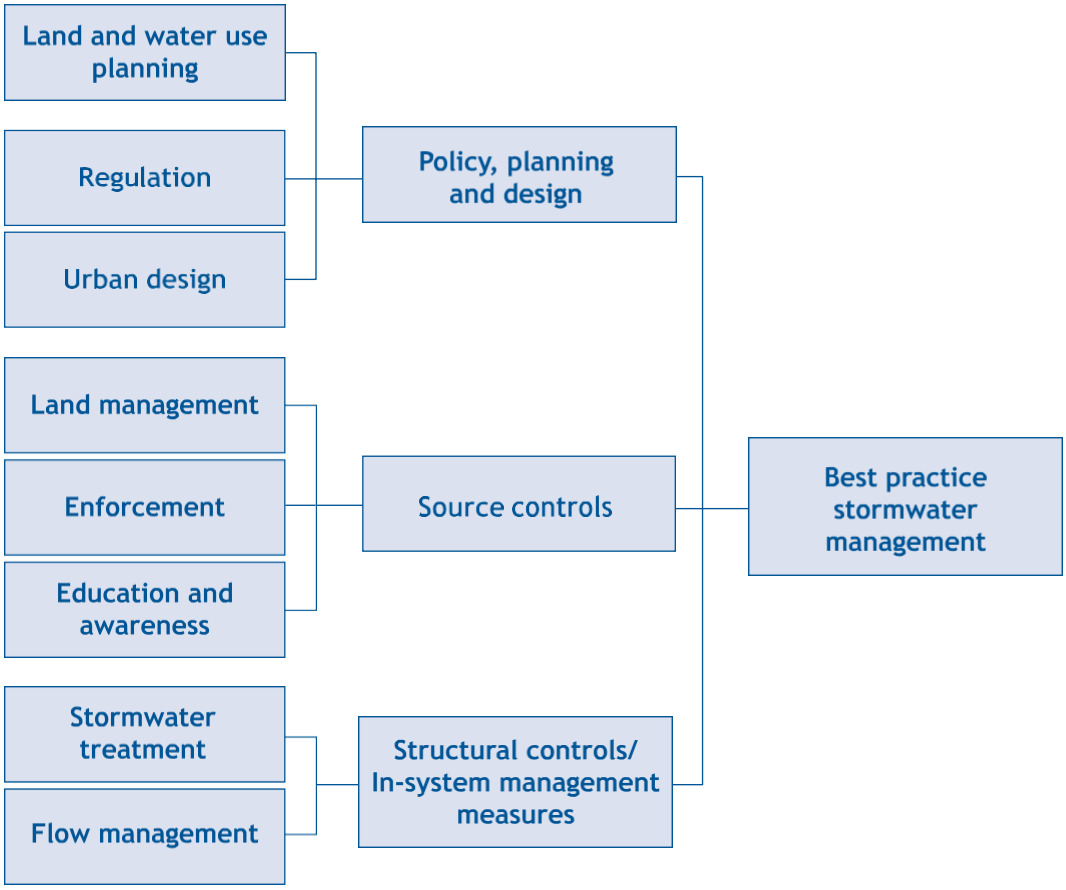

Figure 1: Stormwater management requires the integration of a range of measures (ARMCANZ and ANZECC 2000)

7 How was this manual prepared?

This manual has been prepared in separate chapters that are being released as soon as they are completed. This means that the information can be provided as soon as possible, rather than waiting for the whole manual to be finished. Each chapter is designed as a standalone document, as well as forming an essential part of the whole manual.

This manual was prepared by the former Department of Environment with consultation, guidance and advice from the Stormwater Working Team. The team consists of representatives from State Government and local government, industry and the community. Each chapter has been prepared by subteams from the former Department of Environment, representatives from the Stormwater Working Team, and other participants called on for their expertise in particular areas. The participants on these subteams are listed at the beginning of each chapter. Feedback was given by the Stormwater Working Team on each of the chapters prepared by the subteams. This 2022 version was prepared by the Department of Water and Environmental Regulation.

References

Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) and Australian and New Zealand Environment and Conservation Council (ANZECC) 2000, *National Water Quality Management Strategy: Australian Guidelines for Urban Stormwater Management*, ANZECC and ARMCANZ, Canberra.

Department of Water and Environmental Regulation 2017, *Decision process for stormwater management in Western Australia*, Department of Water and Environmental Regulation, Perth, available www.dwer.wa.gov.au

References details

The recommended reference for overall the manual is:

Department of Water and Environmental Regulation, 2004-2007, *Stormwater Management Manual for Western Australia*, updated 2022, Government of Western Australia, Perth, available www.dwer.wa.gov.au

The recommended reference for this chapter is:

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