BS ISO 24536:2019

BSI Standards Publication

Service activities relating to drinking water supply, wastewater and stormwater systems — Stormwater management — Guidelines for stormwater management in urban areas

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National foreword

This British Standard is the UK implementation of ISO 24536:2019.

The UK participation in its preparation was entrusted to Technical Committee CB/503/-/2, Urban storm water management.

A list of organizations represented on this committee can be obtained on request to its secretary.

It is the committee's view that the scope of this International Standard partly overlaps with part of the scope of BS EN 752:2017 where they both cover the planning of surface water drainage systems. However, the scopes of both standards are wider than this.

BS ISO 24536:2019 applies the same planning principles that were adopted by BS EN 752:2017 for the planning of drain and sewer systems and has copied and adapted text from BS EN 752:2017.

The committee does not consider there to be any conflict between the standards.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Activités de service relatives aux systèmes d'alimentation en eau potable, aux systèmes d'assainissement et aux systèmes de gestion des eaux pluviales — Gestion des eaux pluviales — Lignes directrices pour la gestion des eaux pluviales en zones urbaines

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 224, *Service activities relating to drinking water supply, wastewater and stormwater systems*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

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Introduction

The objectives of stormwater management systems include effective control and management of flows; protection of water quality; preservation of water quantity; protection of the built, public and natural environments; water conservation and reuse; protection or enhancement of ecosystem health; protection or enhancement of public health, safety and welfare; protection or enhancement of social values; and facilitation of sustainable development and climate adaptation.

The Intergovernmental Panel on Climate Change[5] warns that many global risks of climate change are concentrated in urban areas. It indicates that risks are amplified for those lacking essential infrastructure and services or living in poor-quality housing and exposed areas. The key risks, all of which are identified with high confidence, include those of severe ill-health and disrupted livelihoods for urban populations due to flooding from a range of sources including pluvial, fluvial, storm surges and coastal flooding.

According to the UN Department of Economic and Social Affairs[6], the world urban population is expected to increase by 72 % by 2050, from 3,6 billion in 2011 to 6,3 billion in 2050, i.e. by the same amount as the world's total population was in 2002. Virtually all of the expected growth in the world population will be concentrated in the urban areas of the less developed regions, which are deemed to be vulnerable to flooding. The report states that flooding is the most frequent and greatest hazard for the 633 largest cities or urban agglomerations analysed. Mud slides are often associated with severe weather conditions and flooding, particularly in rural areas, and commonly will impact rural villages and small towns, or their associated transportation infrastructures.

Thus, climate change and urbanization with rapid growth in population in cities and surrounding areas are most likely to increase flooding and the risks associated with stormwater worldwide. Serious challenges for stormwater management are posed for an increasing number of stormwater utilities, which are responsible for the control of pluvial flooding, which is caused by rainwater entering and surcharging stormwater systems or remaining on surfaces and flowing overland or into local depressions and topographic lows to create temporary ponds.

The immediate impacts of urban flooding can include loss of human life, damage to property, disruption of traffic and other services and deteriorations of limited freshwater resources, water ecosystems and hygienic living conditions. Effective stormwater management systems can enhance the resilience of communities by reducing the likelihood and severity of pluvial, fluvial and coastal flooding.

Planning methods for stormwater systems have been established in most developed countries but they do not always apply directly to other countries with different conditions. In order to help deliver the best solution to the targeted area, the framework and planning processes should be standardised.

Urban stormwater management is usually the responsibility of municipal water and wastewater service providers. However, in some countries the urban stormwater system management is performed by separate entities specially established for this purpose. Sometimes these services are not financially supported from the municipal water and wastewater revenues but from stormwater levies applied to flood-vulnerable properties concerned and created for that purpose or a local governing authority.

While it is largely historically true that urban stormwater management has been the responsibility of municipal wastewater authorities, it is increasingly recognized that stormwater management may be best or additionally served through collaboration with other relevant stakeholders, such as forestry commissions (for forested hill and mountain sides), agricultural commissions (for upstream farming properties), river authorities or port commissions (for the management of tidal surges on both marine and freshwater bodies) or local governing authorities.

This document can be used for the evaluation of design, operation and performance of stormwater systems. When various kinds of measures are proposed, selecting the best option requires evaluation. The comparison between prospective and retrospective evaluations can lead to the continuous improvement of stormwater management. In providing a common process for the evaluation of proposals to plan/design/procure stormwater systems, this document facilitates fair trade among suppliers.

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Service activities relating to drinking water supply, wastewater and stormwater systems — Stormwater management — Guidelines for stormwater management in urban areas

1 Scope

This document provides guidance to stormwater management authorities and relevant stakeholders on both structural and non-structural stormwater management approaches. The guidance includes consideration of relevant policies, planning, design criteria and implementation processes for stormwater management, and performance evaluation. This document can be applied to new stormwater systems and to the extension or improvement of existing systems for both fully separated and combined storm and sanitary sewers.

This document is applicable to stormwater sewer systems as well as combined sewer systems.

This document is not applicable to sanitary sewer systems.

2 Normative reference

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 24513, *Service activities relating drinking water supply, wastewater and stormwater systems — Vocabulary*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 24513 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

4 General overview

4.1 Principles

The role of the stormwater system should be determined within the context of the whole river basin catchment and the other elements of the urban drainage system (see Figure 1). To determine this role account should be taken of integrated water policies reflected in any national or local regulations or by the relevant authority together with any requirements of the integrated river basin management plan. Account should also be taken of any policies resulting from integrated urban drainage management.

The principles for effective stormwater management include:

— **hydrology**: minimize the impact of urbanization and land management practices on the hydrology of a catchment, including base and peak flows;

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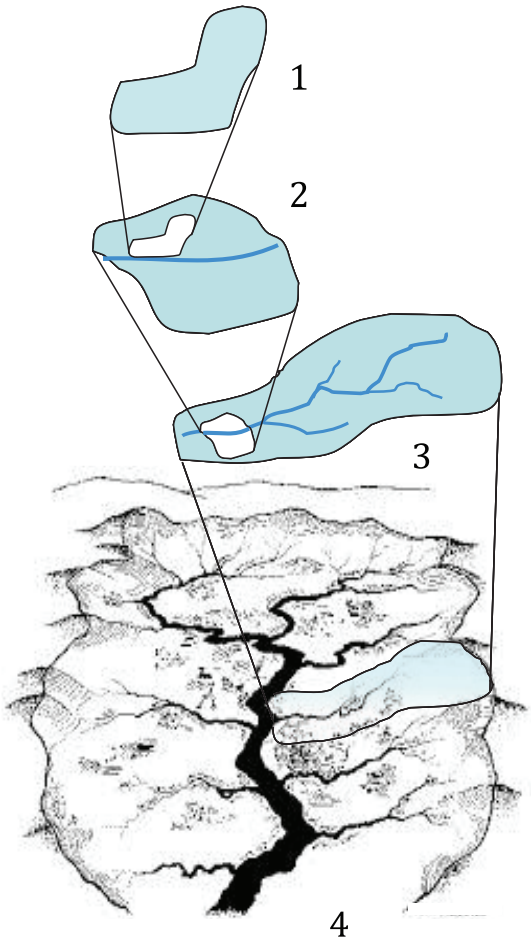
— **water quality**: minimize pollution entering into and discharged from the stormwater system;

— **vegetation**: maximize the value of riparian, floodplain and bank vegetation for flood attenuation, erosion control and water quality improvements;

— **aquatic habitat**: minimize the negative impacts of stormwater discharges on the integrity of aquatic habitats within the stormwater system; and

— **stormwater use**: promote opportunities to identify and use collected stormwater as an alternative water source.



Key

1 local drainage area

2 urban sub-catchment

3 city area

4 river basin

Figure 1 — Relationships between local drainage areas, urban catchments and river basin

4.2 Basic concepts

There are a number of basic concepts that support the objectives for urban stormwater management and that should be addressed during the process:

— flood-resilience and holistic risk analysis for new and existing systems;

— sustainability and responsible resource management;

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— community consultation and involvement;

— consideration of interrelationships between catchments;

— consideration of changing climate, extreme weather and operational stress;

— consideration of lifecycle costs when selecting stormwater management alternatives;

— consideration of asset condition and rate of deterioration.

Figure 2 gives an illustration of a basic concept of a stormwater management system.

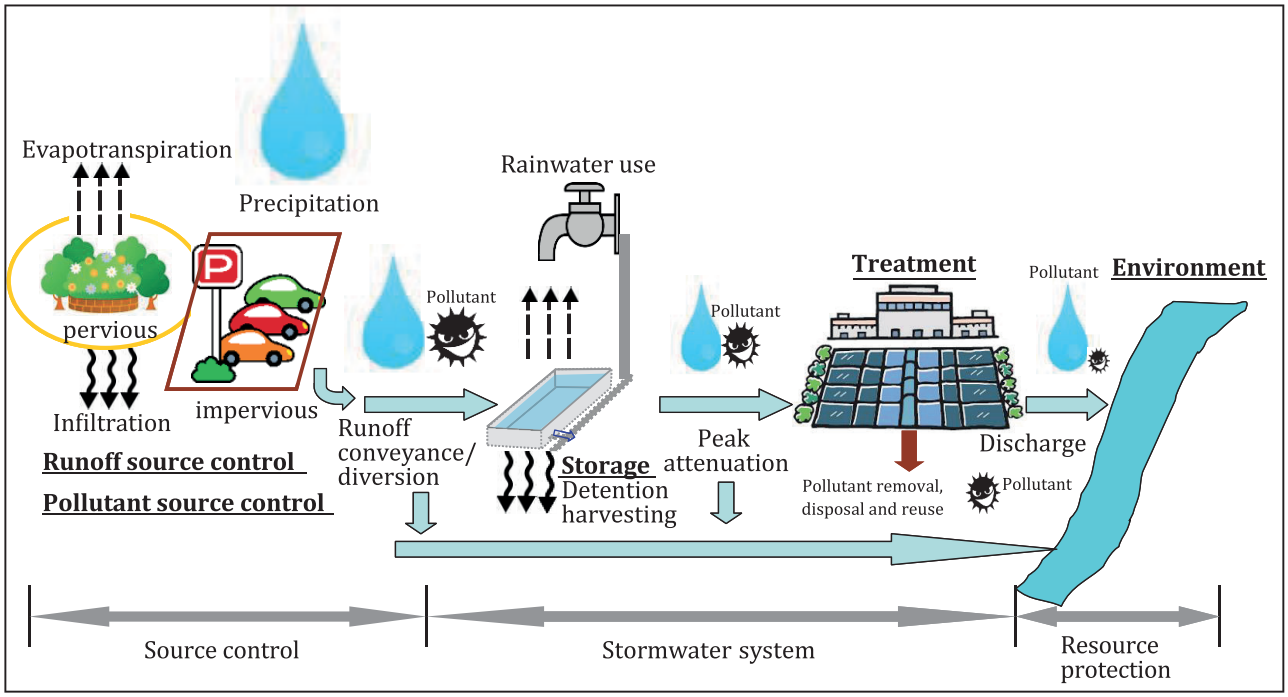

Figure 2 — Illustration of the basic concept of a stormwater management system

4.3 Stormwater management process

As illustrated in Figure 3, the stormwater process relies on the definition of functional and performance requirements adapted to the local objectives of the stormwater system. To ensure the fulfilment of these requirements a continuous management process can be followed that consists of investigation, assessment, planning and performance evaluation.

Both asset-related and non-asset-related solutions can be implemented to achieve the required level of performance.

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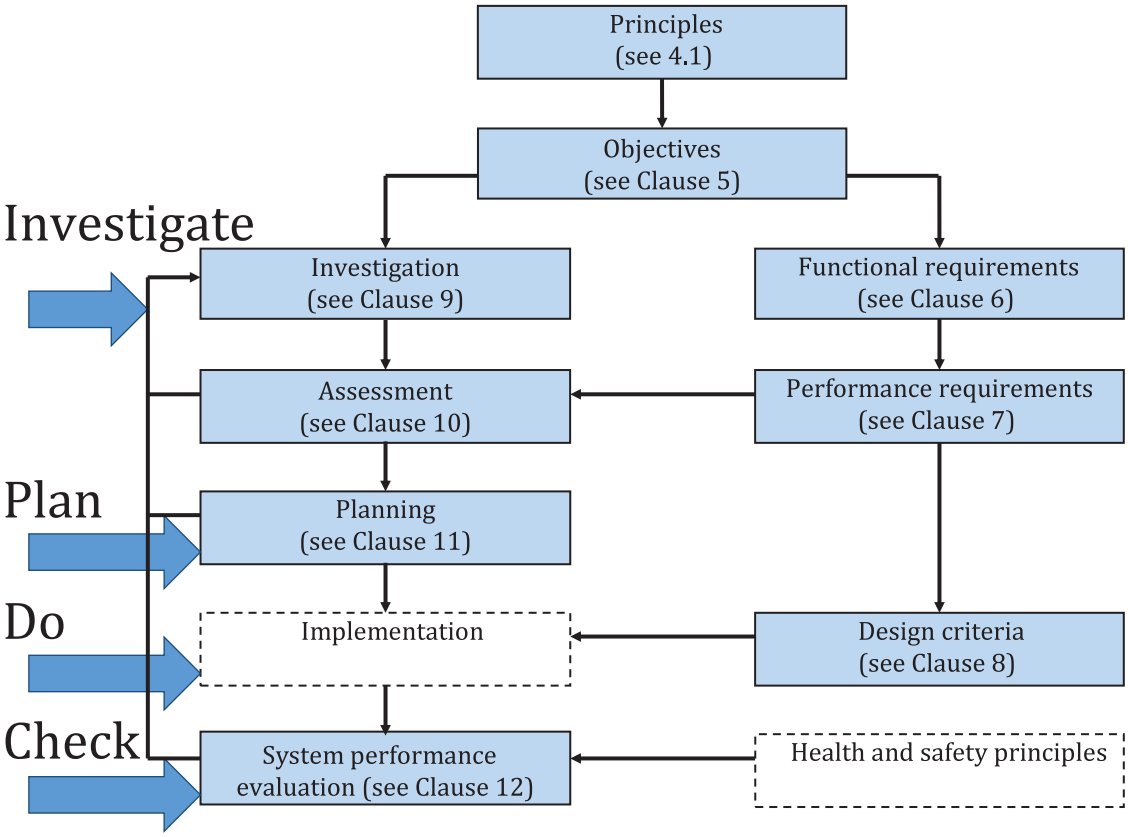

Figure 3 — The stormwater management process

5 Objectives

The objectives to be established by a wastewater or stormwater management utility should:

— be consistent with the stormwater management policy;

— be measurable (if practical).

Objectives can be short-, medium- or long-term and can vary according to the risk and opportunities within the catchment to public and environmental benefit. As such, urban stormwater management systems adopt a number of objectives to ensure that the risks are managed and opportunities realized.

The objectives of stormwater management are:

— effective control and management of flows;

— protection of water quality;

— preservation of water quantity;

— protection of the built, public and natural environments — infrastructure, property and resources;

— water conservation and reuse;

— protection or enhancement of ecosystem health;

— protection or enhancement of public health, safety and welfare;

— protection or enhancement of social values;

— facilitation of sustainable development and climate adaptation.

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The objectives listed in Table 1 are the basis for determining the functional and performance requirements of an urban stormwater management system as illustrated in Figure 4.

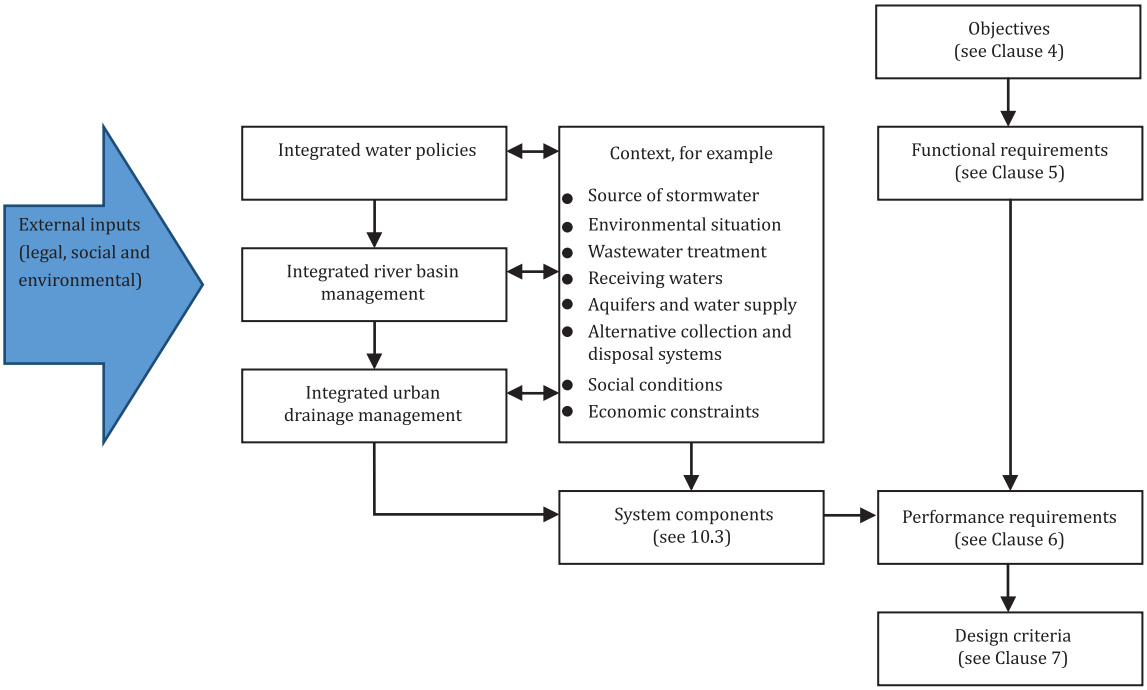

Figure 4 — Process for determining performance requirements from objectives

Table 1 — Urban stormwater management objectives

Objective	Purpose
Effective control and management of flow volumes	— to optimize the stormwater system (e.g. pipe network, flow control device, storage, pumping facility) — to improve the operation of the stormwater system — to set up the stormwater system balancing risk and cost
Protection of water quality	— to support the management of water quality in the receiving surface waters and groundwater — to maintain or improve the surface and groundwater quality in the receiving environment — to reduce the potential for pollutants from the built environment entering the receiving environment — to protect the stormwater at the nearest point of rainfall — to design system resilience to cope with future change
Preservation of water quantity	— to support the management of water quantity in the receiving water — to reduce negative quantitative impact of stormwater drainage from the stormwater system

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Table 1 *(continued)*

Objective	Purpose
Protection of the built, public and natural environments: infrastructure, property and resources	— to use surface water runoff as a resource — to support the management of flood risk in the receiving catchment — to minimize the risk of flooding during rainfall events, including upstream flood risk — to protect the built environment from flooding and waterlogging — to reduce damage to infrastructure and property, and associated financial impacts — to protect resources from occupational health and safety hazards — to reduce and control the potential for erosion and instability of stream banks, vegetation and combined sewer assets — to protect morphology and ecology in receiving surface waters — to preserve and protect natural hydrological systems on the site — to drain the site effectively — to manage on-site flood risk — to design system flexibility/adaptability to cope with future change
Water conservation and reuse	— to maintain the total water cycle balance — to minimize runoff and water wastage — to maximize stormwater reuse through rainwater harvesting to supplement household, commercial/industrial, streetscape and parkland water supply needs — to contribute to recharging of groundwater aquifers
Protection or enhancement of ecosystem health	— to preserve, retain or enhance natural drainage systems and protect ecosystem health — to replicate natural flow regimes so that storm runoff hydrographs resemble pre-development patterns — to support and protect natural local habitats and species — to protect, conserve and retain aquatic habitats and biodiversity through preservation and restoration of natural habitats for flora and fauna — to mitigate deterioration in environmental health — to contribute to the delivery of local biodiversity objectives — to contribute to habitat connectivity — to create diverse, self-sustaining and resilient ecosystems
Protection or enhancement of public health, safety and welfare	— to minimize the risk of injury or loss of life and disruptions to human life, including flooding hazards — to eliminate standing water and consequences of danger from mosquito- and other vector-related diseases

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Table 1 *(continued)*

Objective	Purpose
Protection or enhancement of public social values	— to ensure that social, aesthetic and cultural values are recognized and maintained when managing stormwater — to contribute to attractive and liveable communities — to promote land- and water-based recreational activities and stakeholder satisfaction — to maintain the variety of uses available to the community — to enhance wildlife habitat — to protect and increase property values — to maximize multi-functionality — to enhance visual character — to deliver safe surface water management systems — to support development resilience/adaptability to future change — to support community environmental learning
Facilitation of sustainable development and climate adaptation	— to ensure the delivery of best practice stormwater management through planning and development — to integrate urban drainage into landscape design as part of the initial design phase — to implement stormwater management systems that are economically viable in the long term — to create functional, energy-efficient, low-carbon, climate-resilient cities — to increase potential for land development — to provide an alternative water source to reduce demand and increase reliability of long-term water supplies

These objectives can and should be given full consideration for all types of development. The extent and way in which each purpose can be fulfilled will depend on site characteristics, development context and local objectives. The water quantity and water quality are likely to be the main drivers in determining the design philosophy for a site and these will be supported by expected levels of service for the stormwater management system. Maximising delivery of amenity and biodiversity objectives will often deliver on a range of other required planning outcomes/objectives for the site.

The objectives are not independent of each other. For example, using runoff as a resource will support both water quantity and amenity design objectives.

Generic criteria of good design are required to ensure a safe, functional and cost-effective sustainable drainage scheme. These generally fall into the categories listed in Table 2. In order to maximize opportunities and the associated benefits, these criteria should be considered at an early stage and fully integrated into the stormwater management and urban design process. In so doing, it is then possible to ensure that the scheme is truly multi-functional and delivering the highest return for the developer and for the community who will live there.

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Table 2 — Generic criteria of good design

Generic criteria	Explanation
Constructability	The design of a sustainable drainage system should ensure that it can be effectively and safely constructed.
Maintainability	The design of a sustainable drainage system should ensure that it can be easily and safely maintained.
Acceptability	The design of a sustainable drainage scheme should be acceptable to the public and other stakeholders.
Cost-effectiveness	The design of a sustainable drainage system should ensure that the site is drained to meet the required standards of service, while maximising the potential benefits from delivery of the criteria, at an affordable cost both initially to the developer and for those responsible for the long-term operation and maintenance of the system.
Health and safety	The design of a sustainable drainage system should ensure that it is safe for those living near or visiting the system, and for those involved in its operation and maintenance.

6 Functional requirements

6.1 General

The function of an urban stormwater system at the broadest level is to collect, transport, store and treat stormwater in order to mitigate the water quantity and quality impacts of stormwater flows on the receiving environment. However, for each of these functional requirements, there can be legal requirements, public expectations and financial constraints, which include performance requirements.

Functional requirements are also linked to system goals and cover the drainage system (and sewer systems for combined sewer systems), pumping installations and other components, including requirements resulting from external constraints (e.g. effects on surface receiving water bodies and wastewater treatment plants). The requirements should be considered in respect of the whole system to ensure that additions or modifications to the system do not result in failure to meet the target standards. Asset deterioration monitoring, affordability and the need for society to understand the constraints of the system are critical factors.

Typical detailed functional requirements of an urban stormwater management system include:

— protection from surface water flooding;

— protection from sewer flooding;

— protection of surface receiving water bodies;

— protection of groundwater;

— maintainability;

— structural integrity and design working life;

— sustainable use of products and materials;

— sustainable use of energy;

— protection of adjacent structures and utility services;

— maintenance of the flow;

— watertightness;

— prevention of odours and emission of toxic, explosive and corrosive gases;

— prevention of noise and vibration;

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— input quality;

— protection of downstream drainage systems;

— protection from natural disaster events;

— health and safety principles.

Functional requirements should be determined to ensure that the objectives of the urban stormwater management utility as listed in Clause 5 are achieved. Each functional requirement can relate to more than one objective.

6.2 Protection from surface water flooding

Surface water flooding has an impact on the health of people affected. It can also cause damage to buildings and urban infrastructure. The economic impact can be high and depends on the type of location flooded.

Pluvial flooding should be limited to nationally or locally prescribed frequencies, taking into account:

— the health and safety effects of the surface water flooding (whether it is from stormwater or a combined sewer system);

— the costs arising from surface water flooding;

— the extent to which any flooding on the surface can be controlled without causing damage;

— whether surcharge is likely to lead to surface water flooding of basements.

The hydraulic capacity of the drainage system should limit surface water flooding to nationally or locally prescribed levels and frequencies, taking into account backwater levels. The hydraulic capacity should allow for foreseeable increases in flow over the design working life of the system, including climate change projections.

Other forms of flooding can also impact on stormwater and combined sewer systems, including:

a) fluvial flooding – water from rivers and lakes which flows onto the land;

b) coastal flooding – water from the sea which flows onto the land;

c) sewer flooding – wastewater from drains and sewers which surcharges and flows onto land or backs up into a property;

d) groundwater flooding – water on land when the groundwater level rises and enters into underground structures, such as basements or garages.

The focus of this document is to deal with pluvial flooding. The interaction with other forms of flooding should be taken into consideration.

The effects of flows discharged into downstream receiving water bodies as well as erosion control and runoff reduction should be considered and managed appropriately.

Where there are components in the system which have a high risk of failure, measures should be taken to avoid or minimize the risk of surface water flooding in the event of failure of those components.

6.3 Protection from sewer flooding

Structures, including basements, connected to stormwater or combined sewer drainage systems should be protected from sewer backup caused by surcharge in the system.

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6.4 Protection of surface receiving water bodies

Surface receiving water bodies should be protected from pollution.

The quality of discharges or other impacts from stormwater systems on the surface receiving water bodies should meet the local requirements (including environmental requirements).

6.5 Protection of groundwater

Groundwater should be protected from pollution. The effect of the stormwater system and any cumulative effect of multiple stormwater systems on the local recharge of aquifers and groundwater flood risk should be considered. Where infiltration drainage systems are proposed, the effects of runoff quality and quantity should be considered.

6.6 Maintainability

The system should be planned, designed, constructed and rehabilitated to allow effective maintenance activities that are safe (e.g. risk to personnel is controlled) and cost efficient. Adequate access and working space should be provided for maintenance purposes.

6.7 Integrity of structures

All the components of a stormwater system should be planned, designed, constructed, maintained, operated and rehabilitated to ensure structural integrity over the design working life.

6.8 Sustainable use of products and materials

Products, materials and their use/construction methods should be selected that minimize depletion of finite resources having regard to the design working life of the component and the potential for reuse or recycling, for example minimizing the volume of excavated material and its reuse.

6.9 Sustainable use of energy

The design and operation of the stormwater system should, so far as is practical, minimize the use of energy over the life of the system.

6.10 Protection of adjacent structures and utility services

The planning, design, construction, maintenance, operation and rehabilitation of any component of the stormwater system should not endanger existing adjacent structures or utility services.

6.11 Maintaining the flow

The system should be planned, designed, constructed, operated and maintained to reliably convey all permissible flows that can be collected by the system to the point of discharge, ensuring that the operation of the system is safe, environmentally acceptable and economically efficient.

6.12 Watertightness

All drains, pipes and ancillary structures should be watertight, unless designed to infiltrate to the ground (i.e. sustainable drainage systems).

6.13 Prevention of odours and emission of toxic, explosive and corrosive gases

Stormwater systems should be planned, designed, constructed, maintained, operated and rehabilitated as far as practicable to avoid odour nuisance, or emission of toxic, explosive or corrosive gases.

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