BS ISO 24516-4:2019

BSI Standards Publication

Guidelines for the management of assets of water supply and wastewater systems

Part 4: Wastewater treatment plants, sludge treatment facilities, pumping stations, retention and detention facilities

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National foreword

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Guidelines for the management of assets of water supply and wastewater systems —

Part 4: Wastewater treatment plants, sludge treatment facilities, pumping stations, retention and detention facilities

Lignes directrices pour la gestion d'actifs des systèmes d'eau potable et d'eaux usées —

Partie 4: Stations d'épuration des eaux usées, installations de traitement des boues, stations de pompage, installations de rétention et de retenue

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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*.

A list of all parts in the ISO 24516 series can be found on the ISO website.

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

This document is written within the overall concept of management of assets, which is an activity all organizations undertake in some manner and to some degree. It focuses on the details of managing the physical assets at the operational level rather than the organizational (corporate management, structure or process) level.

Wastewater utilities are reliant on their assets to deliver their services to the users in their service areas. The assets (e.g. underground pipes, retention and detention tanks and treatment plants) collectively form the physical infrastructure of the wastewater utilities and are the consequence of the accumulated capital investments and operational expenditures on maintenance and rehabilitation over many years. In many of these utilities, the replacement value of these past investments will amount to many millions (even billions) of US dollars depending on the size of the community served. The infrastructure represents a major societal investment in essential services contributing to public health and the protection of the environment.

In many countries, these assets have been identified as critical infrastructure and programs are in place to ensure their protection or their sustainability. Like many other organisations with assets, wastewater utilities undertake programs of activities to manage the assets to ensure they continue to meet the needs of the community. These management activities can be at the strategic, tactical or operational level. The activities can be part of a formal management system, or the result of specific legislative requirements, or simply the result of due diligence by the service operators and managers.

This document can serve as a supporting document for utilities operating an asset management system regardless of whether or not the utilities make use of any management system standard, for example ISO 55001.

In many countries, there is a recognized sustainability problem, sometimes referred to as the infrastructure gap, which recognizes that, for various reasons, the infrastructure has not been maintained over the years on a truly sustainable basis, i.e. funding and implementation of rehabilitation programs have been postponed, with a focus instead on short-term repairs, or an allowed decrease in the level of service provided.

The condition of wastewater infrastructures greatly influences the adequacy of the wastewater service from the aspects of quality, quantity, safety, reliability, environmental impact, sustainability, the degree of treatment and efficiency. System condition-based rehabilitation approaches serve to meet these requirements with a focus on a holistic approach of condition-based, risk-oriented maintenance.

As the installation and development of wastewater assets matures, the optimization of the wastewater infrastructure will become necessary in many places in order to compensate for ageing and wear and tear and to respond to changing societal and economic conditions. Consequently, wastewater infrastructure assets are subject not only to ageing and wear and tear but also to adaptation processes resulting from growth, new legislative requirements, technical innovations or changing user-service-level expectations. This requires wastewater utilities not only to focus on maintenance and rehabilitation but also to keep future requirements and developments in mind. Rehabilitation will thus become essential in management of assets, with ever more stringent requirements on the design and execution of rehabilitation.

In recent years, much effort has been applied to the whole issue of management of assets on two levels:

— What are the principles and structure of an asset management system?

— What are the good practices that can be implemented on a technical level to assess the condition of the assets and help decide when asset interventions (repair, renovation or replacement) should take place?

This document describes the information required and how to collect and process reliable inventory, condition, operational and context data about technical assets of wastewater systems, including failures. These data should serve as the basis for a systematic management of assets and can also contribute data needed for benchmarking purposes. A reliable database that supports analysis of failures and

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of operational data (including a description of the condition of facilities or units) is of particular significance for establishing a risk-based investigation to determine maintenance and rehabilitation.

This document also provides guidance on how to define a strategy for management of assets with regard to the overall performance expected by the owner and other stakeholders. It includes several aspects of operation and maintenance, including asset condition assessment and investment strategies (new assets and rehabilitation).

The approaches offered in this document are intended to be universally applicable, regardless of the structure of a given wastewater system. Any empirical numeric values given are mere support values; concrete plans should always rely on utility and/or object-specific values.

The usual and expected goal of the effective management of assets is to provide maximum life and value in a cost-effective manner. However, in some circumstances where the assets are being operated to satisfy a short-term goal, this will not be to maximize the life of the assets, but could, for example, be to minimize costs while meeting other objectives within the planned timeframe.

Additional information on objectives and functional requirements of management of assets is provided in Annex A; an example of the content of a wastewater master plan is provided in Annex B; and examples of inventory, condition and operational data are provided in Annex C. Methods for the risk-based assessment for rehabilitation are shown in Annex D.

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Guidelines for the management of assets of water supply and wastewater systems —

Part 4: Wastewater treatment plants, sludge treatment facilities, pumping stations, retention and detention facilities

1 Scope

This document specifies guidelines for technical aspects, tools and good practices for the management of assets of wastewater treatment plants, sludge treatment facilities, pumping stations, and retention and detention facilities in the wastewater system to maintain the value of existing assets.

NOTE 1 For simplicity in reading this document, reference to wastewater treatment plants includes all the asset types described above.

For further guidance on wastewater networks see ISO 24516-3.

NOTE 2 For simplicity of interpretation of wastewater system assets, the management of pumping stations and retention and detention facilities in the network, excluded from ISO 24516-3, is addressed in this document irrespective of where these assets are sited in the wastewater system.

This document is focused on the assets in wastewater systems typically owned or operated by wastewater utilities that are expected to meet users' needs and expectations over longer, sometimes multi-generational, periods.

This document includes examples of good practice approaches on the strategic, tactical and operational levels.

This document is applicable to all types and sizes of organizations and/or utilities operating wastewater systems.

NOTE 3 Depending on the size and structure of an organization, the utility can decide to what extent it applies the guidance in this document. In any case, the philosophy of this document remains applicable even to small and medium utilities.

NOTE 4 This includes all different roles/functions for the management of assets within a utility (e.g. asset owner/responsible body, asset manager/operator, service provider/operator).

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/

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3.1
asset
item, thing or entity that has potential or actual value to a water utility

Note 1 to entry: Assets are used in a water utility for the provision of the *service* (3.20).

Note 2 to entry: Value can be tangible or intangible, financial or non-financial, and includes consideration of risks and liabilities. It can be positive or negative at different stages of the asset life.

Note 3 to entry: Physical assets usually refer to equipment, inventory and properties. Examples in the water sector are land, buildings, pipes, tanks, treatment plants, equipment and hardware. Physical assets are the opposite of intangible assets, which are non-physical assets such as leases, brands, digital assets, use rights, licences, intellectual property rights, reputation or agreements. Examples in the water sector are water rights, software and databases.

Note 4 to entry: A grouping of assets referred to as an *asset system* (3.2) could also be considered as an asset.

[SOURCE: ISO 24513:2019, 3.6.1]

3.2
asset system
set of *assets* (3.1) that interact or are interrelated

[SOURCE: ISO 24513:2019, 3.5.12]

3.3
asset type
grouping of *assets* (3.1) having common characteristics that distinguish those assets as a group or class

Note 1 to entry: Examples of asset types include, but are not limited to, physical *assets* (3.1), information assets, intangible assets, critical assets, enabling assets, linear assets, information and communications technology (ICT) assets, infrastructure assets and moveable assets.

Note 2 to entry: Examples of physical asset types in the water sector are pipes, valves, pumping stations and reservoirs/tanks of the same type, size, material and function.

[SOURCE: ISO 24513:2019, 3.6.1.1]

3.4
failure
local inadmissible impairment of the operability of an *asset* (3.1) within an *asset system* (3.2) at a certain point in time on a certain asset

[SOURCE: ISO 24513:2019, 3.6.13]

3.5
failure data
data characterizing the occurrence of a *failure* (3.4) event

[SOURCE: ISO 24513:2019, 3.6.15]

3.6
failure rate
ratio of number of *failures* (3.4) of a given category to a given unit of measure

EXAMPLE Failures per unit of *assets* (3.1) and time, failures per number of actions.

Note 1 to entry: For treatment plants, pumping stations and similar facilities, expressed per year.

[SOURCE: ISO 24513:2019, 3.6.14, modified — Notes 1 to 3 removed.]

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3.7
inspection
process to identify the actual status of an *asset* (3.1) or *asset system* (3.2) by observation and judgement accompanied as appropriate by visual control, handling, measurement, testing or gauging

[SOURCE: ISO 24513:2019, 3.5.8]

3.8
investigation
gathering of all information necessary for a decision-making process

Note 1 to entry: This should include both qualitative and quantitative information.

[SOURCE: ISO 24513:2019, 3.5.7]

3.9
level of service
parameter, or group of parameters, which reflect social, political, environmental and economic outcomes regarding the *service* (3.20) to users that the water utility delivers

Note 1 to entry: The service to users can include any of the following parameters: health, safety, user satisfaction, quality, quantity, capacity, reliability, responsiveness, environmental acceptability, cost and availability.

Note 2 to entry: A defined level of service can include any combination of the aforementioned parameters deemed important by the *asset* (3.1) owner, users or relevant stakeholders.

[SOURCE: ISO 24513:2019, 3.3.8]

3.10
life cycle cost
total cost of an *asset* (3.1) or its parts throughout its life cycle

Note 1 to entry: Total cost can include planning, design, construction, acquisition, *operation* (3.13), *maintenance* (3.11), *rehabilitation* (3.16) and disposal costs.

Note 2 to entry: Total cost excludes any residual value obtained during disposal.

[SOURCE: ISO 24513:2019, 3.6.2]

3.11
maintenance
combination of all technical, administrative and managerial actions during the life cycle of an *asset* (3.1) intended to retain it in, or restore it to, a state in which it can perform the required function

[SOURCE: ISO 24513:2019, 3.5.9]

3.12
management of assets
processes during the life cycle of an *asset* (3.1) to maintain value from an *asset system's* (3.2) existing *assets* (3.1) while ensuring an agreed *level of service* (3.9) and function of the system

Note 1 to entry: Processes include:

— all necessary activities for planning, design, procurement, construction/installation, *operation* (3.13), *maintenance* (3.11), *rehabilitation* (3.16) and disposal of *assets* (3.1) of drinking water systems, *wastewater systems* (3.25) and stormwater systems as a functional activity, including their review;

— setting objectives, and functional and performance requirements;

— establishing *strategic plans* (3.22), *tactical plans* (3.23) and *operational plans* (3.14);

— undertaking *investigations* (3.8) including establishing necessary databases, to assess the actual condition of assets during the lifecycle of the *asset system*.

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Note 2 to entry: In ISO 24510, ISO 24511 and ISO 24512 the term "asset management" is used in the meaning of "management of assets".

[SOURCE: ISO 24513:2019, 3.5.2]

3.13
operation
action(s) taken in the course of normal functioning of drinking water systems, *wastewater systems* (3.25) or stormwater systems

EXAMPLE Monitoring and regulation or diversion of drinking water or *wastewater* (3.24).

[SOURCE: ISO 24513:2019, 3.5.10]

3.14
operational plan
documented collection of procedures and information that is developed, compiled and maintained in readiness for the conduct of *operations* (3.13)

[SOURCE: ISO 24513:2019, 3.1.16.1.1]

3.15
performance indicator
parameter, or a value derived from parameters, which provides information about performance

Note 1 to entry: Performance indicators are typically expressed as ratios between variables. These ratios can be commensurate (e.g. %) or non-commensurate (e.g. $/m^3).

Note 2 to entry: Performance indicators are means to measure the efficiency and effectiveness of a water utility in achieving its objectives.

[SOURCE: ISO 24513:2019, 3.9.6]

3.16
rehabilitation
measures for restoring or upgrading the performance of existing *asset systems* (3.2), including *renovation* (3.17), *repair* (3.19) and *replacement* (3.18)

[SOURCE: ISO 24513:2019, 3.5.11]

3.17
renovation
work incorporating all or part of the original fabric of an *asset* (3.1) by means of which its current performance is improved

[SOURCE: ISO 24513:2019, 3.6.16.2]

3.18
replacement
installation of a new *asset* (3.1), which incorporates the function of the old asset

[SOURCE: ISO 24513:2019, 3.6.16.3]

3.19
repair
rectification of a local breakdown or damage

Note 1 to entry: Repair can be planned [e.g. preventive *maintenance* (3.11)] or unplanned (e.g. in the case of damage).

[SOURCE: ISO 24513:2019, 3.6.16.1]

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3.20
service
output of an organization with at least one activity performed between the organization and, in the first place, its user and, in the second place, a stakeholder

Note 1 to entry: The dominant elements of a service are generally intangible.

Note 2 to entry: Service involves activities and processes within an organization (utility), at the interface with the user, to establish user requirements as well as upon delivery of the service and can involve a continuing relationship.

Note 3 to entry: Provision of a service can involve, for example, the following:

— an activity performed on a user-supplied tangible product [e.g. *wastewater* (3.24)];

— an activity performed on a user-supplied intangible product (e.g. processing new connection requests);

— delivery of an intangible product (e.g. the delivery of information in the context of knowledge transmission);

— the creation of ambience for the user (e.g. in reception offices).

Note 4 to entry: A service is generally experienced by the user and can be monitored by one or more stakeholders.

Note 5 to entry: The word "service" in common English can also refer to the entity providing the actions related to the subject in question, as is implicit in such phrases as "bus service", "police service", "fire service" and "water or wastewater service". In this context and usage, "service" implies the entity that is delivering the service, for example "the public transport of passengers", "the provision of public security", "fire protection and response", and "delivering drinking water or collecting wastewater". If "service" can be understood in this way, "water service" becomes synonymous with "water utility"; hence, in this document, in order to avoid confusion, only the definition in 3.20 applies.

[SOURCE: ISO 24513:2019, 3.3.7]

3.21
service life
period of time after installation during which an *asset* (3.1) or an *asset system* (3.2) meets or exceeds the technical and functional requirements

[SOURCE: ISO 24513:2019, 3.6.11]

3.22
strategic plan
document identifying goals and objectives to be pursued by an organization over a long-term period in support of its mission and being consistent with its values

[SOURCE: ISO 24513:2019, 3.1.16]

3.23
tactical plan
document identifying objectives to be pursued by an organization over the medium term, on the basis of priorities derived from influencing factors/indicators on performance, costs, risk and failure probability and scale of *failure* (3.4)

[SOURCE: ISO 24513:2019, 3.1.16.1]

3.24
wastewater
water arising from any combination of domestic, institutional, commercial or industrial activities, surface runoff and any accidental sewer inflow/infiltration water and which can include collected stormwater, discharged to the environment or sewer

Note 1 to entry: Wastewater can flow in separate or combined sewer systems.

[SOURCE: ISO 24513:2019, 3.2.2.2, modified — Note 2 to entry deleted.]

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3.25
wastewater system
asset system (3.2) providing the functions of collection, transport, treatment and discharge of *wastewater* (3.24) and wastewater residues

[SOURCE: ISO 24513:2019, 3.5.12.3]

3.26
wastewater treatment plant
asset system (3.2) to transform wastewater by physical, biological and/or chemical means

Note 1 to entry: The wastewater treatment plant can contain, for example, pumping stations, retention and detention tanks, stormwater storage and overflow facilities, screens, sedimentation tanks, aeration tanks, filters, lagoons, sludge treatment facilities, chemical facilities, odour control and outflow facilities including grilles.

Note 2 to entry: Pumping stations and retention and detention tanks can also be sited in the wastewater network.

[SOURCE: ISO 24513:2019, 3.5.15]

4 Principal aspects of the management of assets

4.1 Objectives and requirements

4.1.1 Objectives

The key generic objectives for the management of assets of wastewater systems are identified from ISO 24510 and ISO 24511:

— protection of public health and safety;

— meeting users' reasonable needs and expectations;

— occupational health and safety;

— promoting the sustainability of the wastewater utility;

— providing services under usual and emergency situations;

— providing sustainable development of the community;

— protection of the environment.

Wastewater utilities should aim to manage their facilities systematically and efficiently in order to sustain their functions. This should take place on the basis of clearly defined objectives, based on assessment and forecasting of the condition of their often extensive and complex facilities.

Setting objectives for the management of assets should help to ensure that wastewater utilities conform with an agreed and sustainable level of service, while also exerting a major influence on the economic performance of the wastewater utility and taking into account risks to the achievement of those objectives. The level of service should be well defined, communicated, tied to risk and current, as customized to a particular wastewater utility.

For further information on objectives of management of assets for a wastewater system see Annex A.

4.1.2 Functional requirements

Functional requirements should be established to aid the achievement of the objectives.

Functional requirements of a wastewater utility cover treating and pumping wastewater and sludge by means of treatment plants, as well as pumping wastewater and sludge in wastewater networks (as part of the wastewater system), including the effects of discharges on receiving water bodies. A

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variety of equipment and facilities support the main functionalities and are also subject to management of their associated assets to ensure sustainable discharge in the natural environment. The functional requirements should be considered in respect of the whole wastewater system to ensure that additions or modifications to the system do not result in failure to meet the target(s).

Functional requirements should be established which, while taking into account sustainable development and whole life costs, including indirect costs (e.g. traffic congestion, military aid provided to the civil authorities), ensure that wastewater systems treat and dependably discharge their contents without causing unacceptable environmental nuisance, risk to public health, or risk to personnel working therein.

Each functional requirement can relate to more than one objective. An indication of the relevance of each of the functional requirements to the achievement of the objectives is shown in Table 1.

Table 1 — Relationship between objectives and functional requirements

Examples of functional requirement	Objective						
	Protection of public health and safety	Protection of occupational health and safety	Protection of the environment	Meeting users' reasonable needs and expectations	Promoting sustainability of the wastewater utility	Providing service under usual and emergency situations	Promoting sustainable development of the community
Elimination of undesirable constituents in the influent	XXX	XXX	XXX	XXX	XX	XX	XX
Protection from flooding	XXX	XX	XXX	XXX	X	XXX	XXX
Maintainability	XX	XXX	XX	XX	XX	XX	XX
Protection of receiving water bodies	XXX	XXX	XXX	XXX	XX	XX	XX
Protection of groundwater/ watertightness	XXX	—	XXX	XXX	XX	X	XXX
Biological hazards	XX	XXX	XXX	XX	XXX	X	X
Prevention of odours and toxic, explosive and corrosive gases	XXX	XXX	XXX	XXX	XX	XXX	XXX
Prevention of noise and vibration	XX	XXX	X	XXX	X	XX	X
Sustainable use of products and materials	—	X	XX	XX	XXX	X	XXX
Sustainable use of energy	—	—	XX	XX	XXX	X	XXX
Structural integrity and design life	XXX	XXX	XXX	XXX	XXX	XXX	XXX
Maintaining the flow	XX	XX	XXX	XXX	XX	XXX	X
Effluent quality	XXX	XXX	XXX	XXX	XX	XXX	XX
Wastewater by-products	XXX	XXX	XXX	XX	XXX	XX	XX

NOTE The number of Xs gives guidance on the importance of the requirement in achieving the objectives.

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4.1.3 Performance requirements

In order to evaluate the performance of the wastewater system and to allow development of design criteria, measurable performance requirements should be determined from each functional requirement.

The process for determining performance requirements is illustrated in Figure 1.

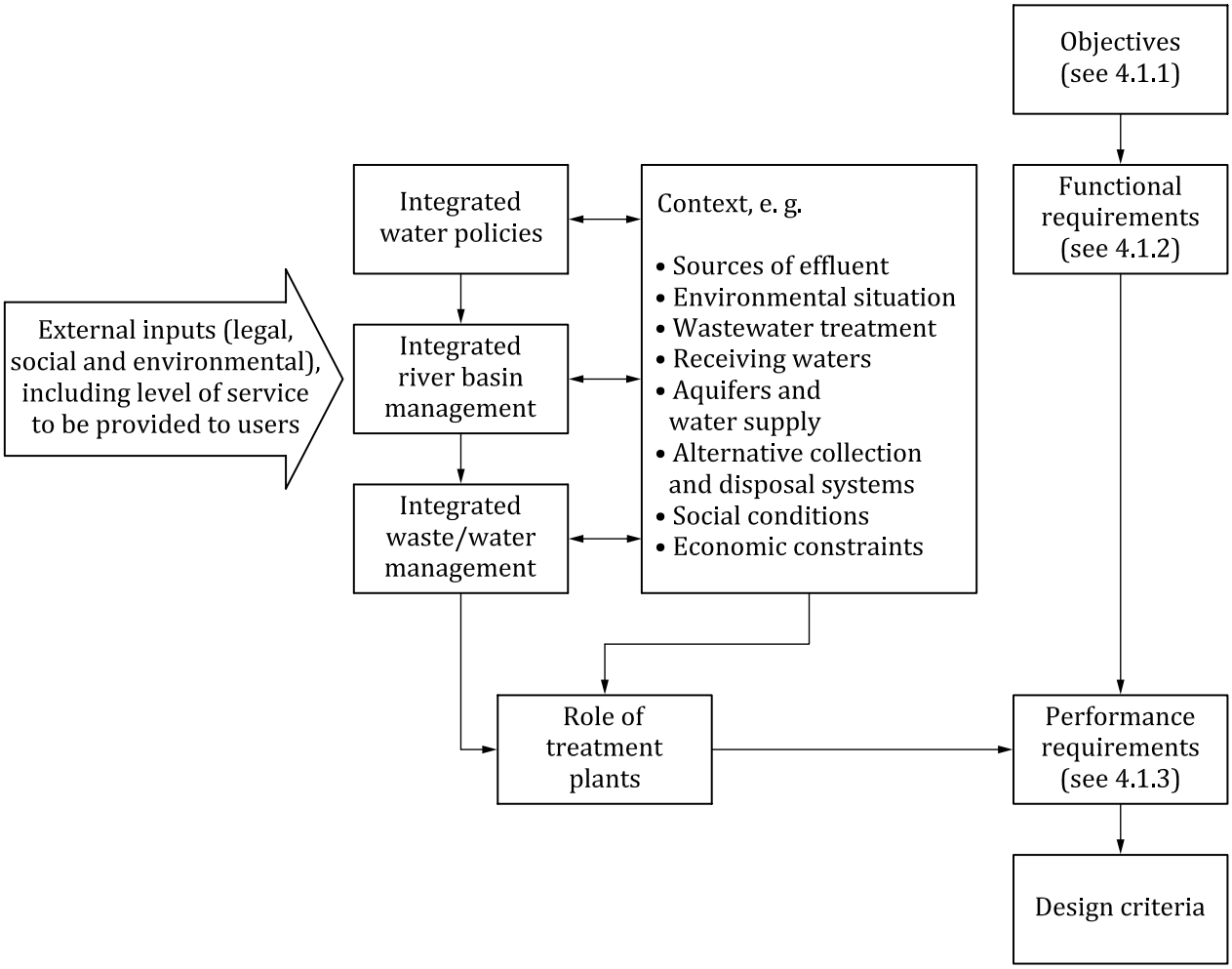

Figure 1 — Process for determining performance requirements

For each functional requirement, there can be legal requirements, public expectations and financial constraints influencing the performance requirements. Public expectations should be reflected in the level of service set by the utility to provide to its users.

For each aspect of performance, different levels can be required, for example:

a) trigger levels which justify early upgrading action according to priority;

b) target levels to aim for in upgrading, which should be equal to the requirements for new construction, but which sometimes can only be achievable or necessary in the longer term.

Performance requirements should be reviewed periodically and updated, if necessary. The performance requirements for the wastewater system should be updated after major extension, maintenance or rehabilitation.

In principle the performance requirements for a rehabilitated wastewater treatment plant should be the same as those for a new treatment plant.

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Performance indicators are essential tools for the understanding of the actual and desired performance of the infrastructure of a wastewater utility, and in parallel, enable indicator-supported infrastructure planning and decision making. Reasonably designed and applied, performance indicators provide information about the condition of the assets and the level of their contribution to the achievement of the objectives of a wastewater utility.

Performance indicators should be defined at strategic, tactical and operational levels, for example:

— strategic: conformance with effluent discharge requirements;

— tactical: reduction of biochemical oxygen demand (BOD), nutrient reduction;

— operational: use of chemicals and energy per m^3.

The performance indicators provide information on how actions at the operational level contribute to achieve strategic-level objectives. Strategic-level indicators are often called “outcomes”, while operational- and tactical-level indicators are called “inputs” and “outputs”, respectively. Operational performance indicators should be compared with action plans [see 7.4 b)].

For further information on objectives and functional requirements see Annex A.

4.2 General aspects

4.2.1 General

In management of assets a distinction can be made between two principal focal points:

— the wastewater utility or responsible body in question;

— that organization’s wastewater system to be managed.

The former could include, for example: strategic financial, reputational and non-operational assets as part of ensuring the wastewater utility's overall objectives are met.

The latter should take into account:

— attention to stakeholders’ (e.g. users, operator, relevant authorities, responsible bodies) requirements, needs and expectations;

— sustainability of the wastewater system and the provided service;

— management of risk, including occupational health and safety exposure;

— local conditions (e.g. climatic, social, technical);

— financial stability of the utility.

4.2.2 Principal aspects — Wastewater utilities

The management of the physical infrastructure of wastewater utilities is recognized as a critical activity to realize users’ and other stakeholders’ expectations. Key activities include:

— the determination of the utility’s current and longer-term objectives;

— planning and implementing activities to achieve objectives;

— the means of measuring the performance of the utility in meeting these objectives;

— the prediction of future amounts of wastewater as an additional basis for rehabilitation.

The management of the wastewater utility’s assets should be directed towards ensuring the utility’s objectives are met.

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Additionally, for ensuring long economic life cycles, proper operation and stable wastewater service this should include:

— knowledge of the layout of the entire wastewater system;

— knowledge of the entire wastewater system together with knowledge on costs (planning, constructing, operation, maintenance and decommissioning);

— knowledge on availability and need of resources;

— selection of appropriate materials and components;

— choice of installation technologies and installation contractors;

— quality control of technologies, facilities, materials used and of wastewater and effluents;

— maintenance of the wastewater system and its assets including routine and incident related inspection and investigation;

— monitoring of operational conditions;

— monitoring the wastewater system's environmental conditions.

Efficient management of assets ensures a continuous provision of the level of service as defined by the wastewater utility in order to meet users' and wider stakeholders' expectations and minimize life-cycle costs.

Management of the assets includes:

— education and training of the personnel to achieve relevant competences;

— maintaining an up-to-date wastewater system inventory;

— monitoring and documenting data;

— assessing the condition of the wastewater system;

— planning, maintaining or rehabilitating the wastewater system;

— operation of the wastewater system in such a manner so as to increase service life while maintaining the agreed level of service;

— optimizing life cycle costs;

— identifying and managing risks;

— ensuring stable wastewater service by taking into account the timing and duration of various rehabilitation works;

— ensuring the wastewater system is utilized/operated as intended;

— protecting the environment from detrimental impacts resulting from the wastewater assets' use.

4.2.3 Principal aspects — Wastewater systems

The management of assets of wastewater systems should cover the complete wastewater infrastructure and the interrelationship of all assets of the wastewater system such as wastewater networks, pumping stations, retention and detention tanks and treatment plants including the resulting effluent quality and its disposal/reuse as well as solids' disposal facilities. In addition, the management of assets should consider changes in needs and expectations/requirements of users and other stakeholders, change in behaviour or usage as well as environmental effects such as climate conditions, population migrations, and demography as far as data are or can be made available. This can be laid down in a wastewater

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