

Concept Note

- for preparation of projects with a holistic approach in the water sector

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1. Background

1.1 Purpose and scope of this Concept Note

The Ministry of Economy and Finance is setting up an initiative that aims to develop sustainable water sector projects integrating multiple activities throughout the water cycle. The initiative labelled “Water project with a holistic approach”, has the ambition to promote a paradigm shift in water sector project planning and preparation. The actions proposed for holistic projects will include an integrated and sustainably approach to the needs of the selected project areas (water, wastewater, stormwater, sludge management, wastewater reuse, digitization/smart metering/telemetry, energy efficiency, etc.)¹. The projects that will be designed with a holistic approach (overall design) will have the possibility to be financed in (coherent) parts.

The objective of this Concept Note is to propose a conceptual framework outlining an approach to preparation of water project with a holistic approach in Greece which are planned to be co-financed by the European Structural and Investment Funds. JASPERS is of the understanding that the water project with a holistic approach will be financed by the European Regional Development Fund (ERDF).

This Concept Note includes guiding principles for the governance of the project preparation and proposals for holistic call criteria. In addition to this Concept Note a separate Guide has been prepared including more technical details to support and assist the Water Service Providers and Technical Assistance consultants in preparing projects with a holistic approach to the water services. The approaches set out in this separate Guide are based on JASPERS’ experience with holistic (integrated) project preparation.

2. Governance

The preparation of ‘water project with a holistic approach’ will be coordinated by the MA PEKA & POLPRO or the Regional Managing Authorities but performed by the Water Service Provider with support from Technical Assistance. JASPERS can assist the Water Service Provider throughout the project preparation when requested by MA PEKA & POLPRO. The level of support will be determined on a case-by-case basis through Assignment Fiche agreements made between MA PEKA & POLPRO and JASPERS.

2.1 Regulatory Authority for Waste, Energy and Water

The Regulatory Authority for Waste, Energy and Water (RAEWW) is, among other, responsible for providing a framework for regulating water services and urban waste treatment, especially in terms of organisation, services provided, their costs and pricing. The responsibilities of the Regulatory Authority is defined in law 5037 of 2023.

2.2 National Managing Authority / Regional Managing Authority

MA PEKA & POLPRO (National Managing Authority) for the Operational Programme 2021-2027 or the Regional Managing Authorities are in Greece responsible for:

¹ Assignment Fiche: Support to the Greek Authorities to define the framework for the implementation of holistic water projects in the Water and Wastewater Sector

- the definition of the structure of the call (structure of invitation for project funding applications) for projects e.g., determine the available allocations, number and clustering of projects, eligibility criteria for participation in the Call.
- The evaluation and approval of project applications for funding.

2.3 Water Service Providers (Beneficiaries)

The Water Service Providers will be the authority preparing the project funding application documentation according to the requirements set in the Call and the requirements for projects co-financed by the European Regional Development Fund (ERDF).

The project funding application documentation is planned to entail Feasibility Study, Cost Benefit Analysis, Environmental Impacts Assessments (Environmental Impact Assessment, Appropriate Assessment and assessment for compliance with the Water Framework Directive) and Climate Proofing Document and Application Form.

For each project application there will be one Beneficiary which could be one of the following types of Water Service Providers:

- One Municipal Water and Sewerage Company (DEYA);
- One Municipal Water Service Department (Municipality);
- A group of DEYAs and/or Municipalities governed by a contract.

Where there are multiple DEYAs/Municipalities benefitting from one project this might require the development of a contractual model laying out the responsibilities of the different parties during the project preparation, implementation, and operational phase. A lead DEYA/Municipality could be identified or alternatively a Legal Entity could be created and entered as the Beneficiary in the project application. The Beneficiary will most likely become the owner of the infrastructure implemented by the project.

2.4 Technical Assistance to the Water Service Provider

The preparation of water project with a holistic approach co-financed by the European Structural and Investment Fund requires specialist knowledge, and the Beneficiaries need to be supported in the project preparation and implementation by external Technical Assistance.

The Technical Assistance could be procured by either MA PEKA & POLPRO or directly by the Water Service Provider. The preferred way of procurement and available Technical Assistance funding will be decided by MA PEKA & POLPRO for groups of projects or on a project-by-project basis.

The Water Service Provider should play a central role in managing the implementation of the Technical Assistance contract and perform quality control of the work and documentation produced. The Technical Assistance needs to be performed in close cooperation with the Water Service Provider.

2.5 JASPERS

JASPERS (Joint Assistance to Support Projects in European RegionS) is ready to provide independent advice throughout the preparation of holistic projects to be co-financed by the European Structural and Investment Fund.

The assistance is provided on request by MA PEKA & POLPRO and can include support in :

- Assessment of the Existing Situation
- Demand Analysis for the project,
- Option Analysis

- Presentation of the Technical Proposal
- Cost Benefit Analysis/Financial Analysis
- Environmental Issues and climate proofing
- Formal Application for National Approval

3. Holistic projects

This Concept Note comprises the elements of the approach to holistic project preparation that should be regarded and tested for development needs.

The analysis' starting from the water source all the way till the end discharge (or reuse) of treated wastewater and sludge.

The necessary details of each step will vary depending on actual needs and local conditions.

3.1 Objectives

The objectives in water project with a holistic approach covers following activities:

Pillars of intervention²

- Securing safe and uninterrupted drinking water supply;
- Securing sustainable wastewater and sludge management;
- Securing Sustainable urban stormwater management and flood risk management;
- Digital transformation, modernisation and increased efficiency in the management and operations and water energy nexus;

All interventions have to consider the European Union legal requirements, including compliance with the “energy efficiency first principle” (EE1st) and “Do No Significant Harm” (DNSH) principles, climate proofing of the investments, application of the circular economy rules, etc. in the planning and decision making.

The responsibility for above activities may be with different authorities/service providers and may have different drivers for prioritisation. Flood risk interventions in a wider context are likely to be outside the urban zone and follow a project preparation process different to that of urban water and wastewater services.

3.2 Geographical area

Ideally the project area covers well-defined geographical area determined by natural service areas and catchment areas as opposed to administrative borders between municipalities. These areas could be defined in Master Plans.

² Comparable to the pillars of interventions proposed in the document ‘The holistic approach in the urban water cycle at Municipality of Rethimnon’ 2023.

Master Plans for water supply services are currently being developed in Greece. Regional ('Master') Plans in the context of extending wastewater network and treatment works for compliance with the Urban Wastewater Treatment Directive were prepared in 2018. In addition, it is necessary to coordinate the proposed investments with the National Plan developed to comply with the Enabling Condition 2.5 of the Common Provisions Regulation.

4. Holistic project preparation

Preparing investment projects planned to be co-financed by the European Union must consider both national regulations and the rules set by the European Union. The requirements will be defined in the 'Call for Proposal' launched by the National Coordinating Authority.

The funding application requirements developed by the National Coordinating Authority should include a formal application and requests for supporting technical, economical/financial and environmental and climate studies. These studies would normally be grouped in 1) Feasibility Study, 2) Cost Benefit Analysis, 3) Environmental and Climate studies.

The objective of developing projects with a holistic approach to the water cycle and service area is to create an efficient and reliable framework that will allow for proper identification of the drawbacks of the water services³, prioritization of the major problems, shaping the engineering solutions (options) and selecting the best ones from technical, environmental, climate and cost-benefit perspectives. Further, the objective is to prove the financial sustainability and technical capacity of the service provider for the long-term operation of the infrastructure implemented in the project.

4.1 Purpose of studies and documentation

A major part in the preparation of holistic investment project is the Feasibility Study and the Cost Benefit Analysis as well as the Environmental Procedures and Climate Proofing.

The Holistic Feasibility Study should be a thorough conceptual framework, which lays down the basis for investment decisions and in the Cost Benefit Analysis the financial sustainability of the Water Service Provider (beneficiary) once the investments are taken into operation is, amongst other, analysed.

Well proven European Union guidance documents for the preparation of Cost Benefit Analysis (CBA) exist. For example the European Union Economic Appraisal Vademecum 2021-2027⁴ which builds on the experience gained in the period 2014-2020, and provides a more flexible, yet rigorous, analytical framework for project Economic Assessment for the 2021–2027 programming period, for voluntary use.

The general purpose of a holistic Feasibility Study should be to define the problem to be addressed in each part of the holistic approach:

- Water Supply;

³ The term Water Services meant here covers the full water cycle from water source to end discharge (or reuse) of stormwater and treated wastewater and sludge end route

⁴ Economic Appraisal Vademecum 2021-2027 - General Principles and Sector Applications.pdf (eib.org) and cba_guide_cohesion_policy.pdf (archive-it.org)

- Wastewater Collection and Treatment;
- Sludge Treatment and Management;
- Storm Water and Flood Risk Management;
- Digital transformation/Operational/Efficiency related issues.

It should establish the desired objective(s) of the study; describe the results of the investigations undertaken; identify options to solve the problem (including estimated costs for all options); recommend the best option for reaching the objective(s) and suggest a phasing plan through short-term and long-term investment plans to achieve the objective(s). While the lowest cost solution is sought, it must be recognised that value is also an important consideration.

All parts of the water cycle should be tested for issues and, if needed, solutions should be suggested.

With regard to the provision of water services, the principal purposes of the key European Directives should be understood;

- The Water Framework Directive is to establish a framework for European Union action in the field of water policy;
- The Drinking Water Directive is to protect public health, through ensuring the water quality complies with certain standards and ensuring appropriate supply; and,
- The Urban Wastewater Treatment Directive is to protect rivers, streams and lakes, through ensuring appropriate collection and treatment of the wastewater generated within the agglomerations.

In addition, complimentary relevant European Union environmental legislation covers sustainable protection/ improvement of the quality of the environment, reuse of water and reuse of sludge.

The Figure below shows the proportional cost of the technical input to each of the stages of a project on the bottom axis and the effect on overall cost on the top axis. The point being made is that the initial studies and decisions have the greatest impact on the final costs. The Feasibility Study costs about 5% of the total project cost and influences about 65% of the final cost.

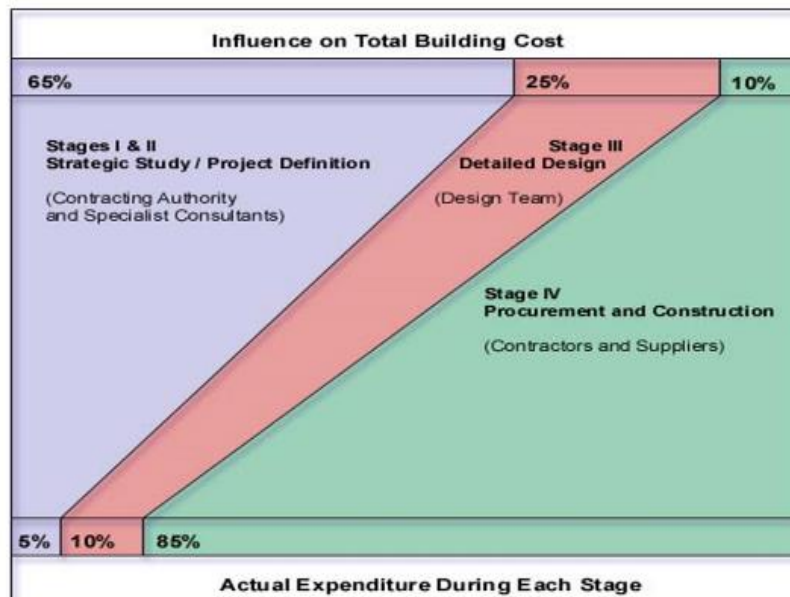


Figure 4-1: Impact of the Feasibility Study on value for money

4.2 Philosophy and development

The development of a **project applying a holistic approach to the water cycle and service area** is of crucial importance for correct identification of the drawbacks of the water services systems⁵, prioritization of the major problems, shaping the engineering solutions (options) and selecting the best ones from technical, environmental, climate and cost-benefit perspectives.

The proposed main building blocks of the holistic project preparation approach are shown in the figure below.

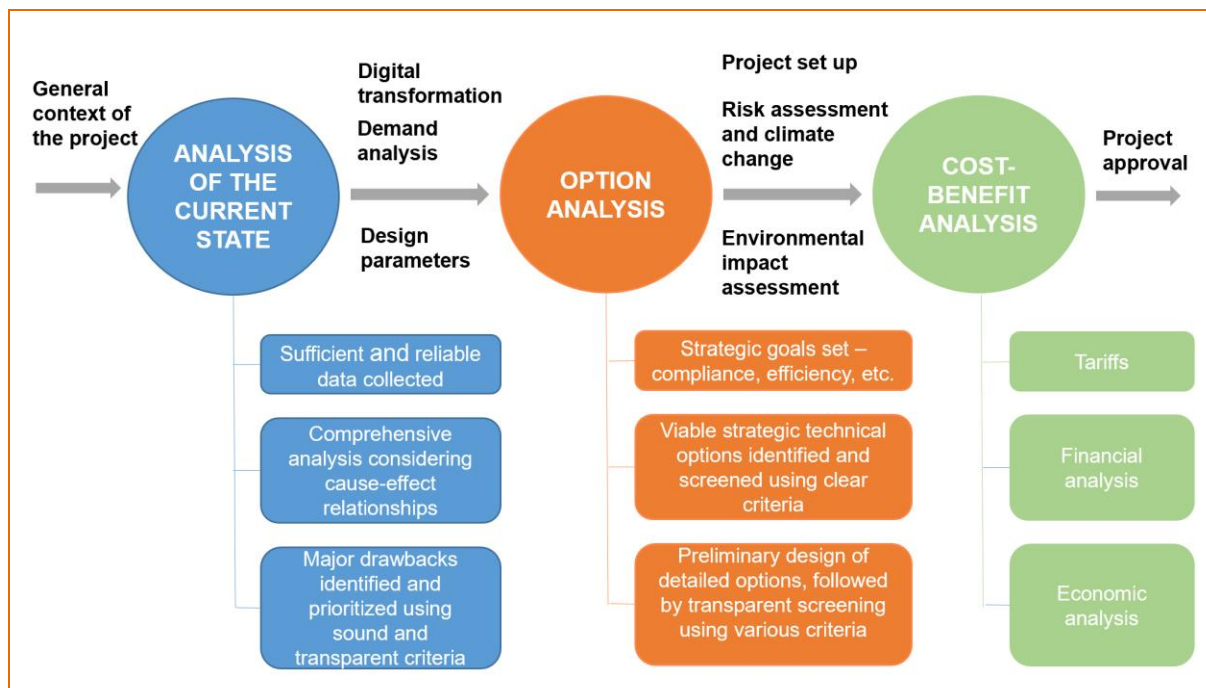


Figure 4.2: Building blocks when applying a holistic approach in project preparation

Considering the available timeframe for project preparation and where local conditions and needs are already well defined, parts of the technical sections of the water services may be analysed on a screening basis.

The analysis of the current state, the option analysis, the Cost Benefit Analysis, the Environmental Impact Assessments and Climate Proofing are the major stages of the development of the Holistic Project Documentation.

The process starts with setting of the general context of the project - European Union directives, state policy and strategic objectives for development and management of the water sector; socio-economic assessment (population growth, economic and industrial development) and the national institutional and regulatory framework. The aim is to understand and explain the bigger picture, in which the proposed project will fit. Regardless of how considerable an impact the project will have in the overall picture, it should be developed in full consistency with legislative and strategic requirements and regional specificities.

⁵ The term Water Services Systems meant here covers the full water cycle from source to end discharge (or reuse) of treated wastewater and sludge management

The first major stage in the holistic project preparation approach is “**The analysis of the current state**”. The way this analysis is performed is the foundation and determines to the greatest extent the quality of the Project. In this stage the existing situation should be comprehensively analysed, based on sufficient and reliable databases. If the existing data is insufficient, old or unreliable, measurement campaigns should be carefully planned and executed. The analysis should consider all cause-effect relationships.

It is envisaged that remediation of all defects of the systems will cost more than the available project budget, hence, the investments should be prioritised into a **short-, medium- and long term investment programme** based on transparent and sound criteria.

In the analysis of the existing situation key deficiencies that will require investment are identified.

It can be assumed that the remediation of all deficiencies of the systems will require more funds than are immediately available, i.e. more funds than the available project budget. Therefore, it is necessary to prioritise and group investment needs into short- medium- and longer-term investments.

Prioritisation into short-, medium- and long-term investments should be based on transparent and sound criteria. These could for example be related to compliance, supply security, impact vs costs, interrelationship to other investments but also related to implementability within the given funding programme timetables (e.g. project maturity - permitting, land availability, design and tender documents). Prioritisation of fragmented infrastructure should be avoided (infrastructure that cannot be put into operation in a timely manner after construction is completed).

Investment in a satisfactory level of digital transformation, modernisation and increased efficiency should normally be included in the short-term with possible expansions in the medium- and long-term investment programme.

The investments prioritised for funding under the Programme 2021-2027 should be grouped and presented as ‘The Project’.

The second major stage is the **Option Analysis (OA)**. Prior undertaking the Option Analysis, two other important analyses should first be performed - demand analysis and determination of the design parameters. These should be consistent with the general project context (e.g. how the region will develop, etc.) as well as with the previous stage - the analysis of the current state (e.g. measured and calculated design flow rate at Wastewater Treatment Plant inlet should be compatible, etc.). The purpose of the option analysis is to select the least cost option, which fulfils the technical and environmental and climate change mitigation and adaptation objectives set. Reasonable and cost-efficient options should be presented to comply with the strategic objectives of the Operational Programme and the requirements in the European Union regulations for co-financing by the European Regional Development Fund (ERDF) .

The selected engineering proposal, i.e. the Project, is then subjected to economic evaluation through **Cost Benefit Analysis (CBA⁶)**, to confirm or reject its economic viability. Embedded in that process risk assessment, climate proofing and environmental impact assessments should be performed.

Note that the objectives of the financial and economic analysis should be:

- Establishment of a Funding Plan for the investment.
- Establishment of a Tariff Strategy, which ensures an equitable balance between Water Service Provider sustainability and end user affordability.

⁶ Well proven European Union guidance documents for the preparation of Cost Benefit Analysis (CBA) exist. For example, the European Union Economic Appraisal Vademecum 2021-2027 and the Guide to Cost-Benefit Analysis of Investment Projects Economic appraisal tool for Cohesion Policy 2014-2020

- Demonstration of adequate Economic rate of Return.
- Achievement (at least in medium term) of Full Cost Recovery Tariff, sufficient not just for operating cost coverage, but also to be able to fund capital replacement needs, as well as to satisfy Polluter Pay Principle.

4.3 Key considerations in preparation

Areas of particular focus and consideration for the Water Service Provider using a holistic approach in the preparation of projects are listed below, these areas have been identified and collated from JASPERS experience from previous studies.

A. Understanding the role and the importance of the holistic project preparation approach

The Holistic Feasibility Study is the foundation of the investment project.

The Holistic Feasibility Study approach should cover all steps in Figure 4.2 and strive to achieve compliance with European Union directives, national requirements and priorities. All sections of the water services should go through the stages shown in Figure 4.2, and this all the way from the water source till the end discharge (or reuse) of treated wastewater and sludge end route.

Simply starting off at *designing engineering solutions* is a common misinterpretation of the role of the Feasibility Study.

The breadth of the Holistic Feasibility Study should not be constrained by past decisions; however these may factor into consideration. The Holistic Feasibility Study should not be oriented to justify previously designed projects, which might not be the optimum response to remediation of the identified problems.

The views and opinions of the staff of the Service Provider are important, and offer insight which is often not present in data; the Water Service Provider should therefore collect as much information from the Water Service Provider's staff as possible. However, the Water Service Provider should exercise its own independent judgement as to the reliability of the information received and the most appropriate remedies to the various problems that prevent the achievement of compliance with the relevant Directives and/or are the reason for non-efficient performance of the water supply and sewerage systems.

The Water Service Provider should understand that his/her role is as **the expert who analyses** the needs of public health and the environment and recommends the optimal solutions for improvement of water services to the public in compliance with the Directives.

B. Data interpretation

Large amounts of data is collected by the Water Service Provider from various sources including from Service Providers, Municipalities and often own measurements.

Thorough interrogation of the data is vital to identify and address erroneous, misleading or false data that may otherwise impact on conclusions drawn, justification of system deficiencies and ultimately Options Analysis.

Review may require questioning of data provided to the Water Service Provider, in particular where field measurements or the engineering judgement indicate contrary trends.

All steps should be approached with equal care and independent judgement: data collection, data verification, data interpretation, data presentation and deriving of conclusions.

C. Unjustified investments

Data is required to support the justification for investment decisions; narrative descriptions to justify investments without the backing sound data analysis should not be acceptable.

For example; justification for a pipe rehabilitation project supported by the statement “*the pipes are old with high water losses*” however, the physical water losses are not determined or backed up with data. This statement would not meet the criteria to support implementation in a project.

The Water Service Provider should avoid narrative descriptions like “many”, “unsatisfactory”, “high”, etc. Numerical values should be used to assure transparency.

D. Selection of criteria for prioritisation of drawbacks or screening of the options

Justification for projects should be measured against criteria. The Project with Holistic Approach should select and state the criteria that will be applied in the analysis of options, and these criteria should be carried forward into the analysis in full.

As an example to be avoided; a long list of drawbacks is provided as a result of the analysis of the current state and later in the option analysis only one of the drawbacks is considered with no explanation why this one was selected.

Every step in Project with Holistic Approach development should be transparent and logically linked to previous steps.

E. Coordination data and interpretation across the Project with Holistic Approach

It is important that there is a consistent approach to the review and interpretation of data throughout the project preparation. Inconsistencies between sections and discipline contributions should be avoided, for example inconsistencies may arise between engineers (e.g. different water supply norm used for water supply system design and for Wastewater Treatment Plant design) or between engineers and economists (e.g. different lengths of the rehabilitated network, different population, different operational costs, etc.).

The Water Service Provider should ensure strong cooperation throughout the entire process. Core data to be used by various experts in a design team should be stored in a shared folder, where any amendments or suggestions for amendment can be shared and agreed. Sufficient time should be envisaged for mid-term and final cross-check.

F. Presentation of the Project with Holistic Approach

Presentation of the Project with Holistic Approach in a consistent and clear manner is important as the extent to which the reader understands the problems the Project with Holistic Approach is seeking to address, the methodology followed in defining the options and the conclusions drawn, will have a bearing on the project success.

The main text should contain:

- Concise but comprehensive descriptions of the applied methodologies and developed analyses with references to the corresponding Annex;
- Concise and comprehensive presentation of the key results (tables, figures) and conclusions with reference to the corresponding Annex(es) and clear referencing to other relevant section(s) of the main text;

Annexes should contain, without being limited to:

- Detailed description of used methodologies for data processing;
- Processable (raw) databases (including all monitoring) that allow checking and tracing of the presented results; the source of each database must be clearly described;
- Detailed analyses and traceable calculations; detailed results in the case of hydraulic modelling;
- Detailed presentation of the results from running models or scenarios (pipe sections, diameters, velocities, pressure, etc.);
- Maps/Drawings/Schematics.

5. Approach to digital transformation

Implementation of smart technologies and digitalisation helps Water Service Providers to increase efficiency in management and operation of Water Services. Water Service Providers are all over Europe progressing in the identification and implementation of the most promising smart technologies and digital transformation relevant for their specific service area and local conditions.

Implementation of new technology comes at a cost and, equally important, resources have to be unlocked for data processing together with training and the creation of organizational willingness towards re-imagining of the business processes.

Water Service Providers are at different stages in the digital transformation and there is no 'fit for all' approach. Digital transformation should be understood as a process where each stage needs careful planning, cost efficiency considerations and embedment within the organization.

Transformation in a staged approach will ensure that the Water Service Providers can adapt, learn, ripe the benefits and mature before the next stage is activated.

Integration of cyber security measures should be an integrated part of the digital transformation process.

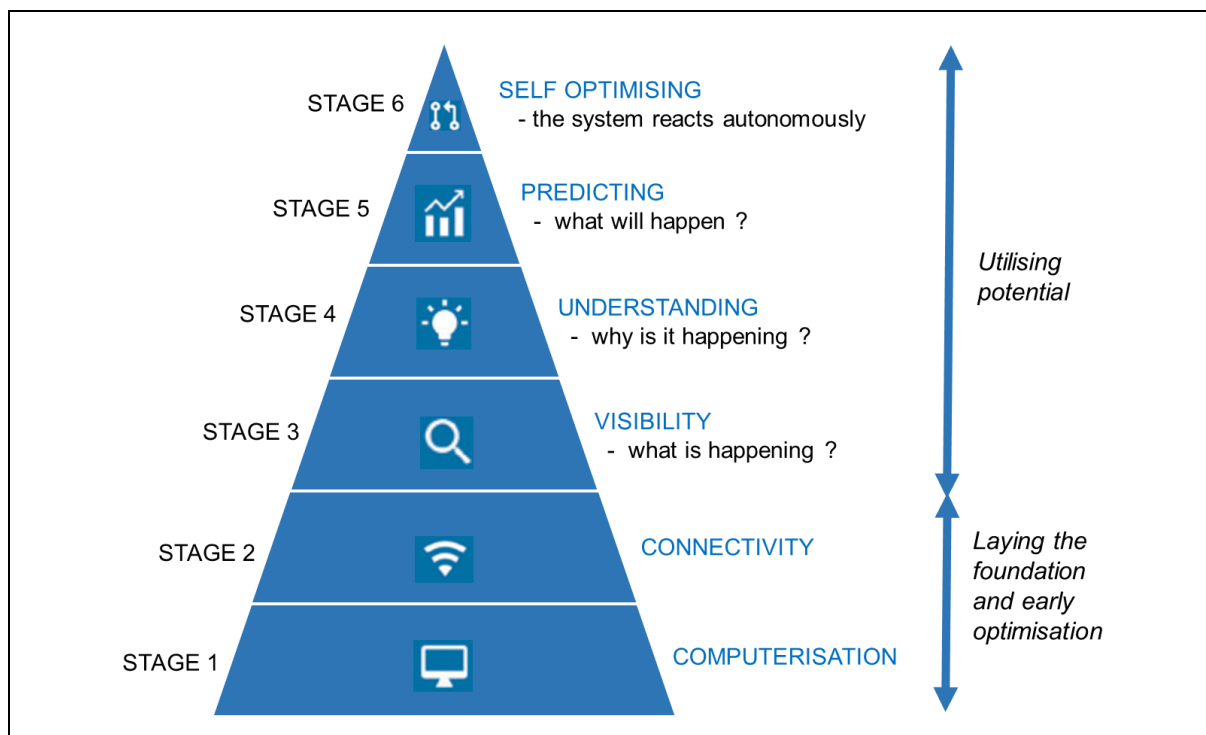


Figure 5: Example showing six successive stages in digital transformation based on the Maturity Check 4.0 by Offermann⁷

⁷ Offermann, M. H. A. (2019). Reifegradmodell Wasserversorgung 4.0. Energie Und Wasser Praxis. <https://www.dvgw.de/medien/dvgw/forschung/berichte/1911offerman.pdf>; Sami, W., White, C., Webb, R., Cross, K., & Glotzbach, R. (2019). Digital water: Industry leaders chart the transformation journey. International Water Association and Xylem Inc..

In the first stages of the process of digital transformation objective setting and implementation is less complex and the results easier accessible. The first stages could entail activities such as full population of GIS (Geographical Information Systems) and Geo-coordination of customers, implementation of SCADA (Supervisory Control and Data Acquisition), online flow and pressure metering, online operation of district metering and pressure zones, other online sensors, active leakage control, automation, etc, etc.

To move further up in the digital transformation process in an effective manner, it is recommended to prepare a Digital Transformation Strategy and a Digital Transformation Roadmap defining, in a staged approach, what is needed to reach the organisation's end objectives.

Having outlined a strategy for the digital transformation the following could be considered when setting up a digital transformation roadmap:

- Analyse the current (digital) state of Water Service Provider business:
 - Identify areas where improvement is needed. Look for processes that are manual, time-consuming, prone to errors and areas where lack of (data) knowledge impedes efficiency in operations, management and asset management.
- Set clear goals for the digital transformation of the Water Service Provider:
- Develop a Digital Transformation Road Map that outlines the steps needed to achieve the goals:
 - Identifying relevant digital technologies/tools, resources needed and analyse how these fits within the organisation.
 - Prepare a staged implementation plan to reach the Water Service Provider objectives over time and start with the most rewarding projects.
 - Develop cyber security plans to protect the digital infrastructure.
- Assign dedicated staff resources and train and educate them on how to use new technologies and processes effectively.

Digital Transformation Roadmaps will be unique for each Water Service Provider, some very basic (the need to have) and others very advanced (larger and more mature water utilities).

6. Approach to demand analysis

Demand analysis identifies and quantifies the social need for an investment. Hence, it must be considered from the design perspective and from the Cost Benefit Analysis perspective. Having in mind that: 1) there should be only one demand analysis for an investment project -, and 2) the designers and economists must consider it from different perspectives. The demand analysis should be disaggregated as much as possible to ensure adequate grounds and a common baseline for both– the designers and the economists.

This can be assured only if a **common multifunctional team**, involving the engineers and economists, is established to work together from the beginning.

The requirements for assessment of the demand analysis are set in the Commission Implementing Regulation 2015/207 Section D.1 of Annex II and 2.1.4.(2) of Annex III (Methodology for carrying out the cost-benefit analysis) to this Regulation. Guidance on the demand analysis is also provided in the

Cost Benefit Analysis guide 2014-2020⁸ (updated with the European Union Economic Appraisal Vademecum 2021-2027⁹).

The European Union Economic Appraisal Vademecum 2021-2027 builds on the experience gained in the period 2014-2020, and provides a more flexible, yet rigorous, analytical framework for project Economic Assessment for the 2021–2027 programming period, for voluntary use.

6.1 Engineers and financial experts' roles in demand analysis

The development of the demand analysis requires very close cooperation between engineers and financial experts.

The engineering analyses of the system provides the background needed by the financial experts for the development of the Cost Benefit Analysis. The project measures identified by the engineers have direct effect on the development and conclusions of the Cost Benefit Analysis. Therefore, the engineering analyses should enable reaching sound conclusions on:

- The water users within the given settlement or agglomeration (types of users, number) and the historic trends of their development;
- The current specific water consumption and wastewater discharge of the different types of users;

For the reference years of the demand analysis, projections concerning:

- the trends of development of the different types of users;
- the water needs and wastewater production of the different users;
- the development of water supply and sewerage infrastructure within a given settlement or agglomeration;

The projections should be developed with the complementary efforts of the engineers and the financial experts. They should consider the current status, the changing culture of water utilisation among the water users and the socio-economic development of the settlement/agglomeration. The Cost Benefit Analysis investigates the “with-project” scenario and the “without-project” scenario reflecting not only the engineering, but also the economic perspective of the projections. Therefore, a common multidisciplinary team involving the experts responsible for engineering work and those responsible for the Cost Benefit Analysis should ideally perform the demand analysis exercise.

⁸ [cba_guide_cohesion_policy.pdf \(archive-it.org\)](https://jaspers.eib.org/knowledge/publications/economic-appraisal-vademecum-2021-2027-general-principles-and-sector-applications)

⁹ <https://jaspers.eib.org/knowledge/publications/economic-appraisal-vademecum-2021-2027-general-principles-and-sector-applications>

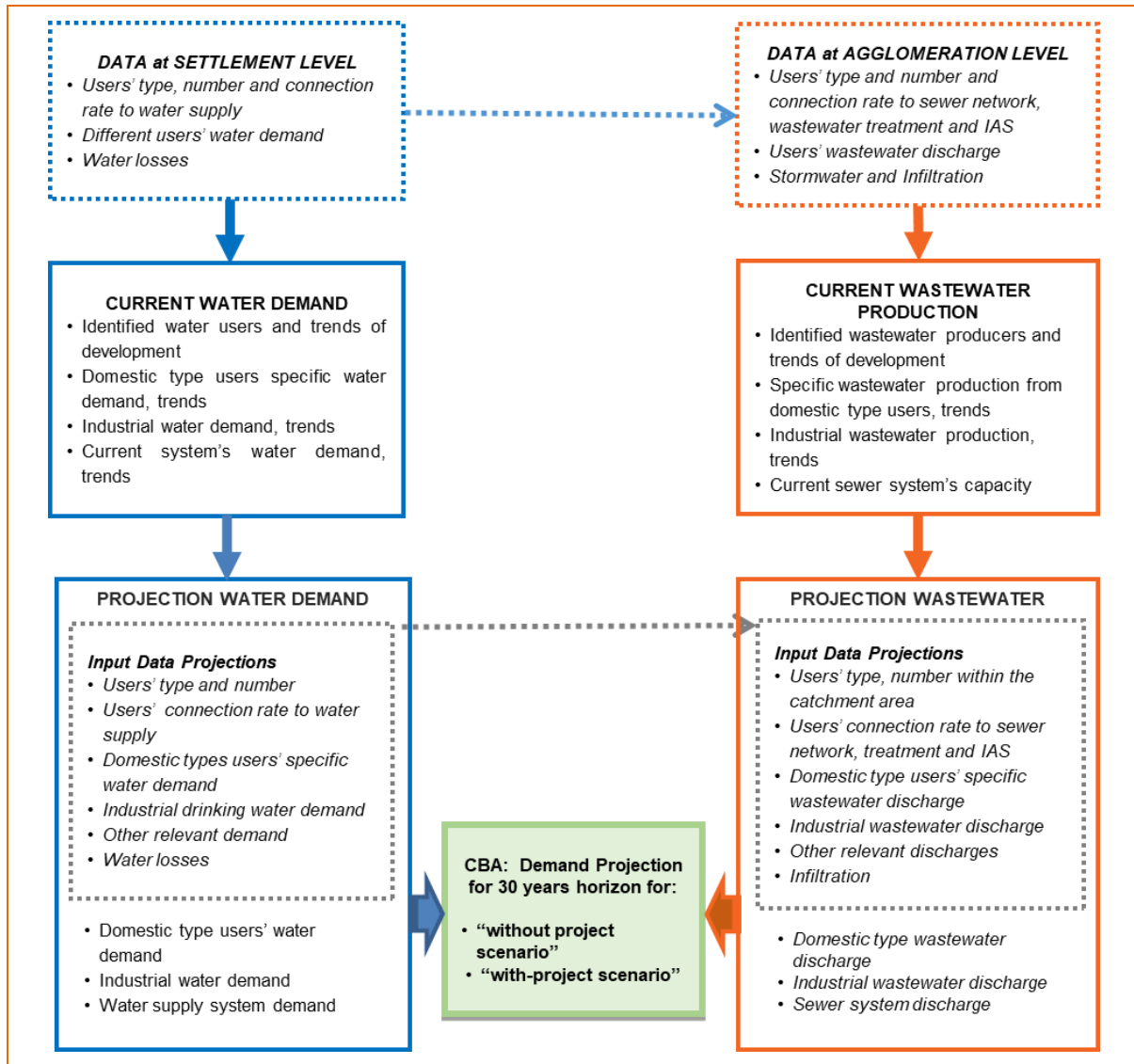


Figure 6.1: Methodological sequence in demand analysis and interactions between engineering and Cost Benefit Analysis (CBA) tasks

6.2 Engineering issues in demand analysis

6.2.1 Data collection

The collection of sufficient and reliable data is a precondition for demand analysis. The data collected is the initial step in the process through engineering, financial, economic and environmental analysis; this is represented diagrammatically in the figure below.

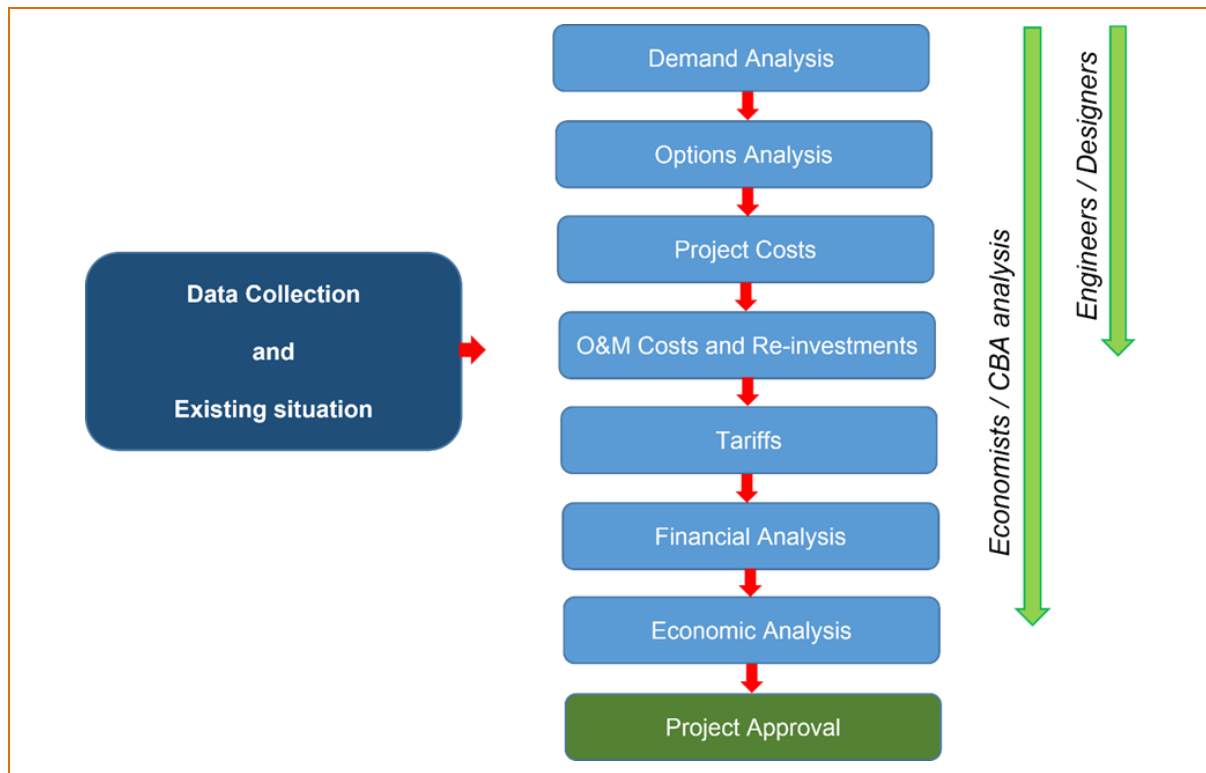


Figure 6.2: Data collection in the project approval process

The methodology of determining the connection rates of the population to the centralized water supply, the sewer network and the Wastewater Treatment Plant should be explained. Even though the distinction between legal and illegal connections may be important in the economic analysis, it has no effect on the engineering demand analysis.

Best practice is:

- Where possible to use official, acknowledged sources of statistical or water services related information. If other sources are used, the methodology of collecting information and data processing should be explained. All the sources of information should be referenced.
- The information concerning water consumption to be based on measured water quantities (i.e. water meter readings). If other approaches are used, e.g. estimations for household water consumption, or specific expert evaluations or indirect evaluation through e.g. pumps operation, they should be clearly indicated and their reliability evaluated.
- If there is an area within the agglomeration, where it is known that there is a concentration of people who are not registered to live there (e.g. socially vulnerable people), then, based on the specific situation, the Water Service Provider should suggest an approach to assess the number of people living there and their demand on the water supply and wastewater systems.
- The water demand and/or the wastewater production of potential users, not currently connected to the municipal network, should not be considered when evaluating the current water demand/wastewater production of the settlement and/or the agglomeration. The Water Service Provider consultant should consider if it is appropriate to consider such likely demands for estimation of future demand.
- Whether the people connected to 'sewers' or 'watermains' that have not been taken in charge by the Service Provider are actually connected to the centralised municipality network should be considered by the Water Service Provider in deciding if they impose a demand on the system.

- The methodology of determining the non-revenue water, especially the physical water losses must be explained. The reliability of approaches which are not based on direct measurement should be evaluated. If there are no reliable data, it is recommended that short term measurement campaigns are executed, especially along the sections that have frequent failures and/or will be subject to project measures.
- The methodology of determining the infiltration into the sewer system must be explained. The reliability of approaches which are not based on direct measurement should be evaluated. If there are no reliable data, it is recommended that short term measurement campaigns are executed, especially in areas with a high ground water table or near river bodies or along sections for which there is evidence of high infiltration.
- For combined sewers and stormwater sewers the methodology of determining the amount of stormwater entering the system must be explained.

6.2.2 Determination of the Type and Number of Users

❖ Current state

The following categories of users should be analysed separately, based on historical data for a period of minimum 5 years.

- Resident population

It is recommended that data from the Hellenic Statistical Authority (ELSTAT) is used and only in exceptional cases data from other sources (e.g. local, regional data). The use of other sources shall be justified and their reliability evaluated. Concentrations of unregistered residents shall be included within this category with an explanation of the reasons for them not being registered.

- Non-resident population, e.g. tourists or temporary residents (migrants, students, military servants), if applicable.

For tourists, it is recommended that data from the ELSTAT and/or local data (e.g. number of available beds, number of beds occupation per annum/month, etc.) is used. For settlements/agglomerations with seasonally intensive tourist activities, the period of “high season” should be clearly defined. The peak number of tourists per day should be determined for the high season.

For other non-resident population (e.g. students, seasonal workers, military servants, etc.) the database used should be explained.

The maximum number of non-residents per day should not be determined as a simple sum of the daily maximum of the different type of non-residents, but through analyses of the period where the maximum concentration of non-residents is expected.

- Public users, e.g. schools, hospitals, Municipality usage, entertainment and shopping premises;

Usually, the Service Provider has information of the type and number of public users and their water consumption. Companies in the service sector that use water only for the daily needs of their personnel could also be regarded as “public” users or evaluated separately.

- Industrial users

The industrial users are those users who use water for industrial purposes. Companies in the service sector that only use water for the daily needs of their personnel should not be regarded as industrial users.

❖ Future projections

The future projections concerning the different users shall be based on sound assumptions, considering:

- The corresponding historic trends of development;
- The expected social and economic development of a given settlement/agglomeration, including likely enlargement of the territory, if applicable;

If the prediction of the future projection trend for some users (e.g. the permanent resident population) differs substantially from the historical trend, a justification for the prediction shall be provided.

If the trend of users' development has been taken from other studies (e.g. ELSTAT prognosis for population development), the assumptions under which the trend have been developed should be mentioned (e.g. ELSTAT hypothesis of convergence or hypothesis of relative acceleration or of relative delay).

6.2.3 Determination of the Current Water Demand

Specific water demand of the different water users

The water demand of each group of users should be analysed separately and by using historical data for a period of minimum 5 years. It is recommended that data provided by the Service Provider is used. Usage of other databases should be justified.

- The specific water demand of the resident population (litre/capita/dayd) should be determined based on water consumed by the residents connected to the centralised water supply service.

If there are residents not connected to the centralised water supply, their water demand should be evaluated separately. The approach for the determination of their demand should be explained.

- The specific water demand for tourists should be based on the number of tourists (or occupied beds) **per day** and the corresponding water consumption of tourist premises for the same period of time (e.g. for high season).

For family type hotels (less than 10 beds) the specific water consumption of the tourists might be quite different from that at bigger hotels. In such cases, if the settlement is with predominantly family type hotels and there is unreliable information concerning the number of available tourist beds and their occupation, it is recommended that the monthly water demand of the resident population is analysed. The difference between the water demand in "high" and "non-high" season might facilitate the determination of the specific water demand of tourists in small family hotels.

The water demand of any other non-resident population (e.g. seasonal workers) should be determined case by case depending on the type of non-resident population and the time they spend in the settlement.

- Public users, e.g. schools, hospitals, entertainment and shopping premises

The specific water demand of the public users is usually expressed as *litres per permanent resident per day*, i.e. the total water demand of the public sector is divided by the total number of the permanent residents.

- Industrial users

A distinction shall be made between the industrial water consumption from the public network and the utilisation of other local private sources by some industries. Only water taken from the public network shall be considered in the demand analysis addressing water supply systems. Nonetheless, those with independent supplies or Wastewater Treatment Plants should be discussed in the Holistic Feasibility Study.

The drinking water demand (from the water supply network) of the major industrial users shall be determined separately for each industrial entity.

The drinking water consumption of non-major industrial users can be determined as a lump sum, subject to site specific analysis.

When determining the industrial daily water demand, the work schedule (i.e. work hours per day) and the seasonal irregularity in the production, if applicable, shall be taken into account.

Water demand at the level of a water supply system

The water demand of the water supply system includes analyses of the systems input water for a historical period of minimum 5 years. The analysis should outline the historic trends of the system's input water quantities. The input water distribution should be at least split into revenue water (i.e. purposeful water consumption by the different users) and non-revenue water.

Special attention should be given to the non-revenue water and especially the physical water losses. The latter should be consistent with the conclusions of the IWA water balance.

The water demand of the water supply system should analyse the sufficiency of the existing water sources and identify any need for extension/additional water sources.

Any interruptions of the water supply over the past 5 years should be indicated and appropriately categorized, showing the reasons, the affected population and the duration. This information will support the evaluation of the project proposal benefits.

6.2.4 Determination of the Projected Water Demand

While there should be consistency in the predicted demands used in various parts of the Holistic Feasibility Study, it is recognised that some of the existing data might not be absolutely accurate and some regard should be had for international norms. The Water Service Provider shall in any case propose own estimated realistic value for future demand in the study area according to the available data and trends.

Input data projections

Besides the projection of the number of users, several other input data projections must be made in advance to enable the determination of the projected water demand:

- The expected specific water demand of the different type of users at the reference years;
- The expected connection rate of the users to the public water supply system (if different from 100%);
- The expected change of water losses;

Both number of users and input data projections should refer to the same year.

Forecast specific water demand values (litre/user per day) should be developed separately for each group of domestic type users (e.g. permanent residents, tourists, public sector).

Any ongoing projects for rehabilitation of the water supply network should be considered, e.g. their effect on the future performance in terms of change of the water losses rate.

All the projection input data values should be well justified, considering the expected socio-economic development, the culture of water utilisation and the up-to-date national and European Union framework concerning sustainable water utilisation.

Projected water demand of each group of users

The projection of water demand of each group of users should be determined based on their expected number and specific water demand. Key design parameters (e.g. $Q_{\max,d}$, $Q_{\max,h}$) should be also determined:

- For domestic type users (permanent and non-permanent residents), the key design parameters should be calculated by considering the irregularity of the water consumption.

If the existing database is sufficiently detailed (i.e. daily values and hourly water consumption values are available), the coefficients of daily and hourly variation shall be determined case specific, based on the existing data. Where existing database information is deemed not sufficient, good engineering practice shall be applied.

- Drinking water use from the public network should be developed for each of the major industrial consumers, based on their managers' expectations/programs concerning future development.

For non-major industrial units, the forecast drinking water use from the public network could be determined as a lump sum based on the forecast for social and/or economic development.

For industrial type users, the coefficients of daily and/or hourly irregularity should be determined by considering the working hours and the seasonal specificity of their production.

The water consumption pattern of the different groups of users is usually quite different and it is not recommended to use the same coefficients of irregularity without appropriate justification.

Projected water demand at the level of a water supply system

If possible (i.e. if there is sufficient database, allowing appropriate analysis) the projection of water demand of the whole water supply system should not be determined as a simple sum of the projected maximum daily water demands (i.e. $Q_{max,d}$) of the specific groups of users, but through analysis of the maximum daily demand of the whole system.

If new settlements are connected to the water supply system, their projected water demand shall also be considered.

The expected share of the water losses at the reference years shall be well justified through the proposed project measures and shall be consistent with the Option Analysis and the Cost Benefit Analysis.

6.2.5 Determination of the Current Wastewater Generation

Specific wastewater production of the different type of users

Similar to the water supply demand, the wastewater production shall be analysed separately for each group of users. In the context of the Urban Wastewater Treatment Directive (Directive 91/271/EEC) The wastewater infrastructure should be evaluated at the scale of an agglomeration (or catchment area), i.e. only the users within the boundaries are considered in the wastewater “demand” analysis.

- Domestic type users

The wastewater production of the domestic type users (i.e. permanent and non-permanent residents) is usually determined as a percentage of the corresponding specific water demand.

The wastewater production of domestic type users within the agglomeration boundaries that are currently not connected to sewer network shall be evaluated separately but considered within the future demand analysis.

- Industrial users

The wastewater production of each of the major industrial units shall be evaluated separately.

The utilisation of other local or non-potable water sources, if relevant, as well as the water included in the production, should be considered when determining the corresponding wastewater production. It is recommended that the database provided by the Service Provider is used.

Industrial and/or public users that shall continue to discharge unmixed wastewater (i.e. originating from their activities alone) into water bodies subject to individual permission shall not be taken into account in the demand analysis.

Capacity of the wastewater system

Depending on the type of the system (i.e. separate or combined) the following key components should be analysed in addition to the wastewater amount collected by the users currently connected to the system;

- the drained storm water (for combined and separate systems)
- the infiltration

Usually, the storm water contribution is evaluated through specific national regulations and design norms. It is recommended that modern approaches are used (i.e. sewer system hydraulic modelling),

which enables development of different scenarios and accounts for the attenuation ability of the sewer collectors. Climate change impact on the intensity and volume of rain should be taken into consideration in the hydraulic modelling.

Whenever there is an existing Wastewater Treatment Plant, the level of infiltration shall be estimated through analyses of the Wastewater Treatment Plant inlet flow in dry weather. If there is no existing Wastewater Treatment Plant or main sewers, the share of infiltration shall be estimated by applying regulatory and/or good engineering practice approaches. The source of the data shall be referenced.

Whenever, there is a substantial difference between the theoretical wastewater production by the users connected to the Wastewater Treatment Plant and the measured inlet Wastewater Treatment Plant flow in dry weather, the possible reasons should be profoundly analysed and reported in the Holistic Feasibility Study.

6.2.6 Determination of the Projected Wastewater Generation

Input data projections

Besides the projection concerning water supply demand, projections must also be made concerning:

- The type and number of users within the agglomeration boundary;
- The expected connection rate of the users to the public wastewater system;
- The expected change in the quantity of infiltrating water;

All the input data projections should refer to the same year. The extension of the sewer network, if relevant, should be consistent with the conclusions in the Option Analysis.

Any ongoing projects for rehabilitation/extension of the sewer network should be taken into account, i.e. their effect on the future performance in terms of number of newly connected users and/or change of the infiltration rate.

Projected wastewater production of the different users

- Domestic type users

The wastewater production of the domestic type users that will be connected to the sewer network is determined in a similar way as for the current state, i.e. a percentage of the corresponding specific water demand.

The wastewater production of domestic type users within the agglomeration boundaries but not envisaged to be connected to sewer network shall be evaluated separately.

- Industrial users

The wastewater production of each of the major industrial units shall be evaluated separately, following the above-mentioned considerations for the current state.

Projected capacity of the wastewater system

The projection of the capacity of the wastewater system is determined considering the type of wastewater system, the design wastewater flows of the existing and the newly connected users, as well as the expected contribution of the stormwater drainage and infiltration.

6.3 Demand analysis - Cost Benefit Analysis perspective

For the Cost Benefit Analysis following is still recommended as a minimum:

- Description of the methodology/models used for projections, e.g. trend extrapolations, questionnaires/interviews, etc.

- Baselines and corresponding assumptions – the demand in the past disaggregated by users and settlements for water supply projects, and users and agglomerations for wastewater projects. It should be based on actual data (e.g. data from the regional offices of the National Statistics Institute, the Service Provider, the respective municipalities, the Energy and Water Regulatory Commission, the financing institutions, etc.). Future demand without the project for 30-year time horizon (disaggregated by users and settlements for water supply projects, and users and agglomerations for wastewater projects) should reflect the macroeconomic and sector forecasts, supply side aspects including the analysis of existing supply and expected (infrastructure) developments without the project (based on the relevant and approved Municipal and Sectorial Development Plans, etc.), cumulative effects of on-going projects, and ideally – the elasticity implications.
- Demand projections for selected options and corresponding assumptions - the future demand with the project for 30-year time horizon including implementation period, disaggregated by users and settlements for water supply projects, and users and agglomerations for wastewater projects, reflecting the macroeconomic and sector forecasts, supply side aspects including the analysis of existing supply and expected (infrastructure) developments with the project (based on the relevant and approved Municipal and Sectorial Development Plans, etc.), cumulative effects with on-going projects, and ideally – the elasticity implications.
- Connection rates (disaggregated by users and settlements for water supply projects, and users and agglomerations for wastewater projects).
- Abstracted volumes, physical losses, administrative losses, infiltration to the sewerage network, frequency and duration of water supply interruptions, pricing policies and affordability ratios;
- Demand projections at the end should be aggregated (with clear and traceable links) at Water Supply System level;
- Demand risks related to:
 - water consumption lower than predicted;
 - connection rate to public sewage system slower than predicted.

7. Approach to Options Analysis

Options Analysis is required under the conditions of European Union funded projects. It must be objective, as it is critical to coming to the correct solutions within projects in order to find the 'least cost' solution to the problem at hand.

Logical options need to be assessed; options which are not viable need to be culled at an early stage.

The 'do nothing' option is generally not a viable option, although it can be used to justify rehabilitation projects when it is properly priced (breaks, costs to householders and commercial operations during outages etc).

While the LOWEST COST solution is normally sought, it must be recognised that VALUE, environmental impact and climate change are also to be consider in the Options Analysis.

On the figure below are presented the main steps in the development of option analyses.

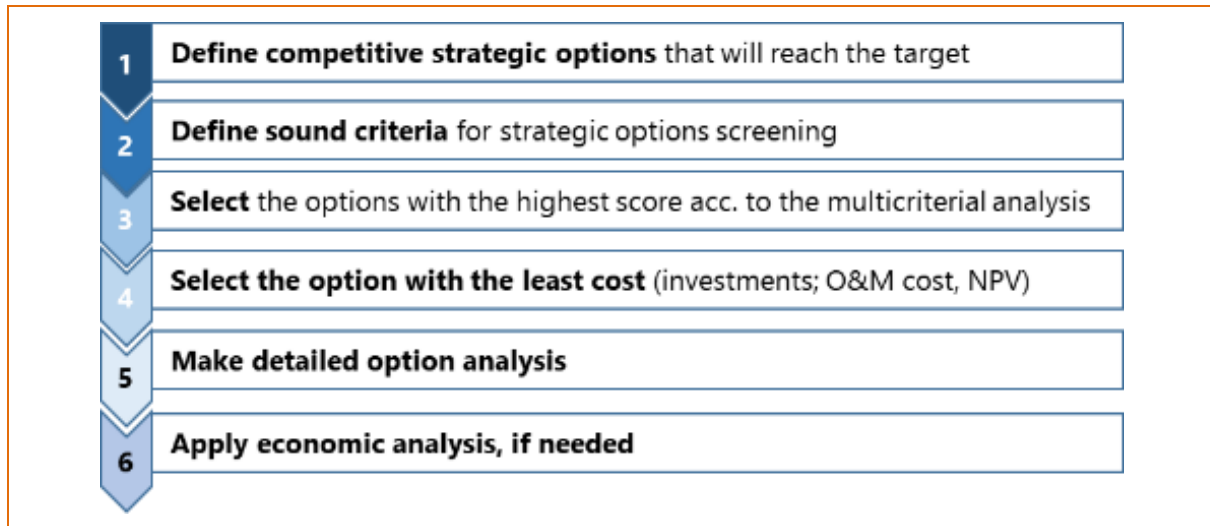


Figure 7: Methodological approach when developing option analyses

It should be highlighted that not all steps in figure 4.5 may be applicable in an Options Analysis, this will depend on the type of problem to be solved, the options that can be defined and the local context.

7.1 The Options Analysis at a more strategic level

7.1.1 The purpose of the analysis

Starting the Options Analysis at a more strategic stage allows a number of different options to be reviewed and evaluated against a set of pre-determined criteria, leading to the selection of the preferred options. This stage can commence once the overall project strategy, existing situation, the demand forecast and the deficiencies in the existing infrastructure have been properly assessed.

To evaluate the options, 3 main criteria should be used:

- **desirability** - the degree to which each option meets the strategic objectives and requirements
- **feasibility** - the degree to which each option can be implemented
- **viability** - the degree to which each option is financially viable and sustainable

In terms of water supply; the strategic options to be analysed in the area of a water infrastructure project should aim to develop water systems that ensure compliance with the water quality requirements of European Union Directives and local National Regulation in relation to direct influence on human health, ensuring operational safety, continuity in the provision of water supply, removing current inefficiencies, functioning with acceptable O&M costs and allowing for expansion in the future.

For wastewater collection; strategic options may include whether the proposed networks will be foul sewer only, fould sewers with green/blue solution for storm water or separate systems with two pipes. Combined sewer systems should not be considered an option unless there are special conditions that can justify the choice.

The strategic options for wastewater treatment will generally involve either 'centralised' or 'decentralised' options, depending on whether the agglomeration being assessed can be viewed as being part of a cluster or not.

A strategic Options Analysis may have already been included in the Master Plan (if it exists) as an initial assessment to provide a 'preferred options' list. This assessment does not preclude the need for further and more detailed assessment as the Water Service Provider prepares the Holistic Feasibility Study (with the help of a technical assistance consultant).

Different Options (or combination of options) should be examined in the Project with Holistic Approach. The Holistic Feasibility Study should detail the description of the options and their evaluation and assessment. This should then lead to the selection of the preferred option and justification for its proposal.

There will be many different options (solutions) to the problem being addressed, which have to be identified, assessed and compared. Assessment and comparison of each option should include environmental, technical, organisational and economic aspects of each option. On the basis of the results of the Options Analysis, the most feasible and cost-effective option (or a combination of options) is selected. This preferred option should reduce the negative impact on the environment and allow the Service Provider to attain the planned objectives at the lowest costs possible.

The assessment of options should be an analytical process, explaining and justifying the conclusions and proposed solutions. The selection of final feasible options for detailed analysis should be the result of a stepwise assessment, rejecting less suitable or less attractive options as it proceeds. As a result, only a small number of options will need detailed analysis. In order to be able to reject less suitable options, assessment criteria are necessary. General criteria that can be used include:

- technical suitability and operational reliability;
- environmental impact;
- climate change mitigation and adaptation
- compliance with the Do No Significant Harm principle
- costs and cost recovery;
- acceptability to the public.

7.1.2 The screening of options

The main focus should be to ensure that the Service Provider will be able to supply the required services under either water supply or wastewater management during the life cycle period of the proposed project in a cost-effective manner. In terms of demand, if a deficit between supply and demand is forecast at any point in the life cycle, the project needs to plan the actions that will be necessary to resolve that deficit. In order to properly plan these actions, the Water Service Provider needs to evaluate a range of options, select the preferred set of options and justify their choice (Multiple Criteria Analyses). Water Service Providers should adopt a consistent approach to the analysis and estimates of costs for all of the options in the Holistic Feasibility Study, so that the results are comparable.

When selecting a list of feasible options for detailed analysis, the Water Service Provider should show that they have considered all of the factors relating to the options. **They should consider the financial, environmental and social costs as well as issues such as climate change, energy needs, operation & maintenance costs and wider environmental concerns.** Consultants should also consider the risks and uncertainty associated with the options and their overall flexibility.

7.1.2.1 Water Framework Directive

When promoting an option, its potential impact should be considered in the context of the environmental objectives of the Water Framework Directive.

For example: Where an option involves taking more water from a water resource which is currently defined as over-abstracted or over-licensed, it should be considered likely to have an impact on Water Framework Directive ecological status. Water Service Provider should make a judgement on the level of risk this poses to the implementation of that option and how acceptable they find this risk. Similarly, recipients of treated effluent subject to other pressures on their ecological status should also be carefully considered. Surface, coastal and groundwaters need to be taken into account.

7.1.2.2 Other environmental considerations

In addition to the overall sustainability and efficient use of water resources, it is necessary to consider other relevant environmental criteria:

- presence of protected areas (impacts on biodiversity: Natura 2000 sites other (nationally protected nature areas), drinking water protection zones, bathing protected areas, etc.) and compliance of the project with the protection measures, objectives and prohibitions set for the protected areas,
- other sensitive areas (for noise protection, air quality, etc.)
- impacts on cultural heritage and material assets,
- waste generation, etc. as appropriate and relevant

7.1.2.3 Climate change considerations

At least the following climate consideration should be taken into account with the OA:

- **climate change mitigation:** e.g. reduction of Greenhouse Gas (GHG) emissions, energy efficiency, energy use, contribution to the implementation of the targets set in the National Energy and Climate Plan (NECP) contribution to the implementation of the targets set in the national climate change strategic documents, etc.;
- **the compliance with the Energy Efficiency First principle:** Chapter 4.6 of Commission Recommendation (EU) 2021/1749 of 28 September 2021 on Energy Efficiency First: from principles to practice — Guidelines and examples for its implementation in decision-making in the energy sector and beyond: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021H1749&from=EN> provides guidance specific to the water sector;
- **the decarbonisation pathway** and compliance and contribution to the 2030 objective to reduce the emissions by 55% compared with 1990 levels and with the 2050 climate neutrality objective;
- **climate change adaptation:** at this stage it makes sense to make a vulnerability assessment of the key alternatives. This means to assess the sensitivity of the components and the exposure of the locations. Be reminded to make the sensitivity assessment for the type of component and NOT for the specific project. The exposure assessment should be made for the location irrelevant of the project. Such an approach would allow for the identification of climate hazards that may create risks in the future. An early identification of the vulnerabilities would help the selection of options with less vulnerability to climate change. Compliance with the National Climate Change Adaptation Strategy: should also be checked.

7.1.2.4 Compliance with the Do No Significant Harm principle

It is important to be informed about the outcome of the Do No Significant Harm assessment carried out with the preparation of Operational Programme 2021-2027. In case this assessment identifies any measures, these should be taken into account when the project is prepared. Other Do No Significant Harm criteria may be introduced with the calls under Operational Programme.

7.2 The Options Analysis at a more detailed level

Options Analysis on a more detailed level considers various solutions to ensure the most cost-effective investment as regards capital investment (CAPEX) and operating & maintenance costs (OPEX), expressed as net present value (NPV).

Water Service Provider should provide a description of each option with supporting information including:

- the main features of the option, including how it will work

- a schematic map illustrating the scale, source of supply and areas over which the option is to be implemented
- a conceptual diagram showing the main operational features
- a schematic showing any links or dependencies to other options
- for leakage reduction or water efficiency options: a description of the baseline demand savings or leakage management savings and how the option being described differs from this
- proper estimation of the capital investment (CAPEX), operating & maintenance costs (OPEX) and net present value (NPV)

Following on from the screening exercise in 6.1 a cost analysis is required. Each option must be priced according to the basic unit costs determined and presented in the Holistic Feasibility Study. It is critical that these basic unit prices are objective and transparent.

It is worth remembering that one should try to make the assessment of the various options as easy as possible to understand for the people who will be assessing the options and proposals. In this regard, elements which are common to all options do not need to be included in the analysis of the NPV; these elements should however be described fully in the analysis.

The CAPEX will include the estimated costs of construction, plant and equipment for each option, on the basis of the information as understood and using the basic costs as outlined in the Water Service Provider's cost estimate for the project.

The OPEX will be calculated on the basis of the annual costs of Energy, Materials and Reagents, Wages, Maintenance and Replacement, over the life cycle of the project (25 or 30 years as appropriate).

NPV will be calculated on the basis of the discount rate for the Programme.

When the final detailed analysis is carried out, the Risk Table should be updated to review the outcomes at that stage, with the financial risk ranked on the NPV of the particular option.

8. Approach to identification of project measures Water Supply Schemes

It should be recognised that water services are dynamic natural activities and are not readily amenable to exact quantification. Mathematical and computer modelling can improve understanding of the phenomena, but water services engineers must develop expertise to understand the intrinsic inaccuracies in the assumptions, estimates and empirical practices that may exist. All water services engineering is based on experience, approximations and estimates and very little can be quantified exactly. In the absence of considerable relevant proven data, accuracy is impossible. The specific requirement of the European Union Directive is that if a consumer is supplied with drinking water, the water quality must comply with the Drinking Water Directive (2020/2184/EEC¹⁰).

8.1 Conceptual issues

The main questions that should be answered through these analyses are:

¹⁰ Directive 2020/2184/EEC: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020L2184>

- Is the quality of drinking water in compliance with the requirements of the Drinking Water Directive?
- Is there a sufficient quantity of water to ensure the current and projection water demand needs?
- What should be done to secure that the drinking water has appropriate quality and is sufficient. What should be done to increase the efficiency of water source utilisation, efficiency of treatment and operation of the Drinking Water Treatment Plant and distribution system?

Depending on the answers to these questions project measures shall be suggested for improving the current state and ensuring water in sufficient quantity and with good quality for the project horizon.

Directive (EU) 2020/2184 on the quality of water intended for human consumption (i.e. the Drinking Water Directive) introduces a number of changes, reflecting the current state of art of the science concerning drinking water quality and the World Health Organisation approach based on risk assessment for ensuring water quality throughout the water supply systems. Some of the new topics of Drinking Water Directive 2020/2184 are:

- Introduction of new additional drinking water quality parameters;
- Requirement concerning the way of assessment of water leakages, i.e. to be based on the methodology of infrastructural leakage index (ILI)
- Requirements concerning the development of Water Safety Plans;
- Requirements concerning the materials in contact with water.

Figure 4.6 outlines the main steps in the development of the analyses of water supply systems.

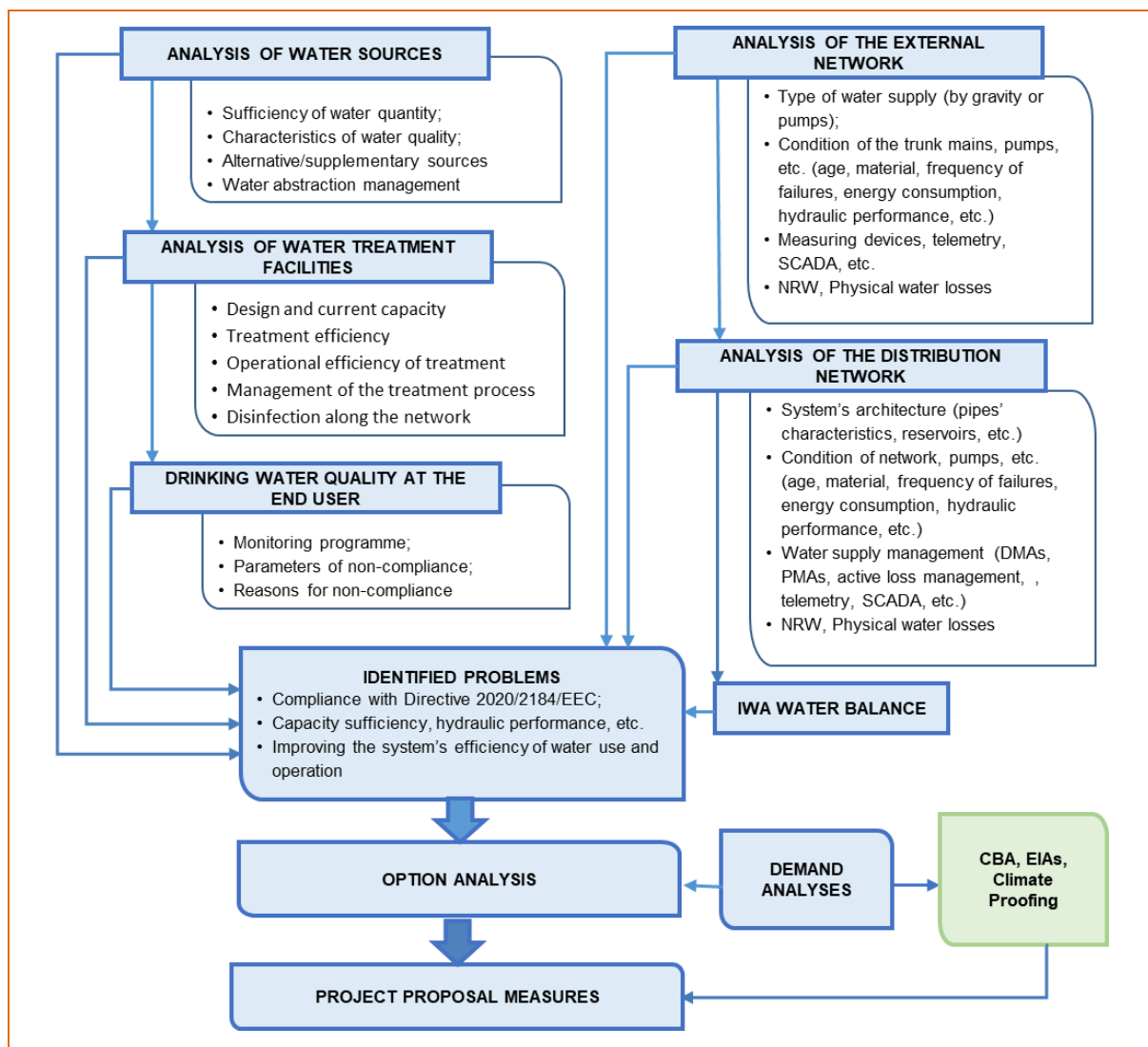


Figure 8.1: Methodological sequence in identifying project measures in water

8.2 Analysis of the existing situation

8.2.1 Water Sources

The water sources are a critical element for each water supply system and their type, character, water capacity and water quality shall be analysed thoroughly. The analyses should encompass the following key issues:

- The availability and reliability of the existing water sources, including their climate change and anthropogenic vulnerability, e.g.:
 - Sufficiency of water quantity;
 - Tendencies in water quality and the need for treatment
- The availability and reliability of alternative and/or supplementary water sources, including their climate change and anthropogenic vulnerability, e.g.:

- Sufficiency of water quantity;
- Tendencies in water quality and need for treatment
- The management of water abstraction(s)
 - Existence of sanitary protection zones
 - Is the abstracted water metered?
 - Status of the water abstraction facilities;
 - The methodology of managing water abstraction automatized/distant management (i.e. SCADA availability)

8.2.2 Water Treatment Facilities

The needs for water treatment should be based on the analyses of source water quality. Based on the conclusions concerning the quality parameters that are not in compliance and their respective parametric limit values, the efficiency of treatment of the existing Drinking Water Treatment Plants and the need for construction of new treatment facilities shall be analysed.

It has to be noted that the approach for the analyses of the performance of the existing water treatment or development of new treatment facilities should consider both quality of the source water and drinking water quality requirements as per Drinking Water Directive 2020/2184.

8.2.3 Drinking Water Quality at the End User

Drinking Water Directive 2020/2184 regulates the drinking water quality at the end user, therefore a distinction should be made between the quality of the treated water at the outlet of the Drinking Water Treatment Plants and the quality of drinking water at the tap of the consumers, although the criteria of compliance, with small exceptions, are the same.

Some parameters, e.g. microbiological indicators, colour, taste, odour may change along the network due to contact with the old, dilapidated pipes or due to random failures within the distribution network.

8.2.4 Engineering issues

8.2.4.1 Water losses and burst records

Special attention should be given to the non-revenue water and especially the physical water losses. The latter should be consistent with the conclusions of the IWA water balance.

Flow measurements and pipe burst records are useful data for the determination of pipe sections with the highest losses.

8.2.4.2 Pipe Corrosion

Corrosion of metal pipes is often quoted as a justification for replacement of pipework. Such a contention should be supported by evidence; this could be a combination of rate of bursts/leakage, pipe wall measurements and estimated remaining pipe lifetime. In case of corrosion due to aggressive water a corrosivity index such as Langelier index should be measured and new investments accordingly protected (corrosive resistant pipe material / treatment of the water).

8.2.4.3 Flow Velocity

Velocity in the pipe being too low due to the pipe being larger than necessary to convey the flow, resulting in settlement of suspended solids in the pipe is occasionally used as a justification for pipe replacement. Optimum velocity in water distribution pipes is recommended in EN 805. However, at the extremities of a distribution system, with very low demands, these velocities are generally unachievable,

resulting in sedimentation in the pipe. The sedimentation may cause a deterioration in the bacteriological quality of the drinking water to users below this point for as long as the sediment remains. A further problem may be caused by the resuspension of this settled material into the water flow to the consumer. Common remedial measures could include;

- avoidance of “dead ends” in water networks, by the use of ring mains.
- More effective treatment at the Drinking Water Treatment Plant to remove the sediment before it gets to the pipework
- frequent “flushing” of the pipe to wash out the sediment.

It is possible that trunk lines were constructed in times when the water usage was predicted to be greater than realised. Accordingly, the pipe sizes in some trunk mains may be larger than technically necessary, and it is often alleged that the water quality deteriorates due to age in such pipes and that therefore the pipes should be replaced. Even though retention time in some distribution networks can be over a week, this doesn't necessarily cause any major problems with well treated drinking water. Three days is often considered as the dividing line between young and old drinking water.

For new transmission pipes *the diameter of the pipes can be optimised in terms of investment and operating costs.*

8.2.4.4 Minimum pipe diameter

The minimum pipe diameters should be observed, as specified in National and European Union Design Standards.

Notwithstanding the requirements, pipes should not be replaced solely because of unduly small diameter, unless there are other compelling reasons for replacement.

While even smaller pipe diameters might be considered in order to increase the flow velocity to the EN 805 recommended levels, this will not be possible at very low flows, where demand is sub-minimal. The impact from fire hydrants shall be considered.

8.2.4.5 Pumping Stations

In respect of pumping stations energy efficiency estimation should refer to energy consumption kWh/m³ per meter pumping head (the pumping head through which the liquid is pumped).

8.2.5 Supply Management in the Distribution

District Metering Zones and Pressure Reduction Zones permit greater control of excessive pressures in distribution systems and better identification of leakage.

Telemetry, automation, SCADA, etc. enable monitoring and operation of remote locations from the Service Provider offices. These options are constantly improving and the Service Provider should explore the potential of modernisation according to best available technology and maturity of operations (i.e. considerations of investments where the Service Provider has the capacity to reap the benefits).

9. Approach to identification of project measures in Wastewater Schemes

The specific requirement to the wastewater schemes is set out in national legislation as well as in the European Union's Urban Wastewater Treatment Directive¹¹.

9.1 Methodological sequence in identifying project measures

The sequence in identifying project measures regarding the collecting system and Wastewater Treatment Plants is the same as for all other components of the projects. The specificities of the steps in regard these systems are visualised in the figure below.

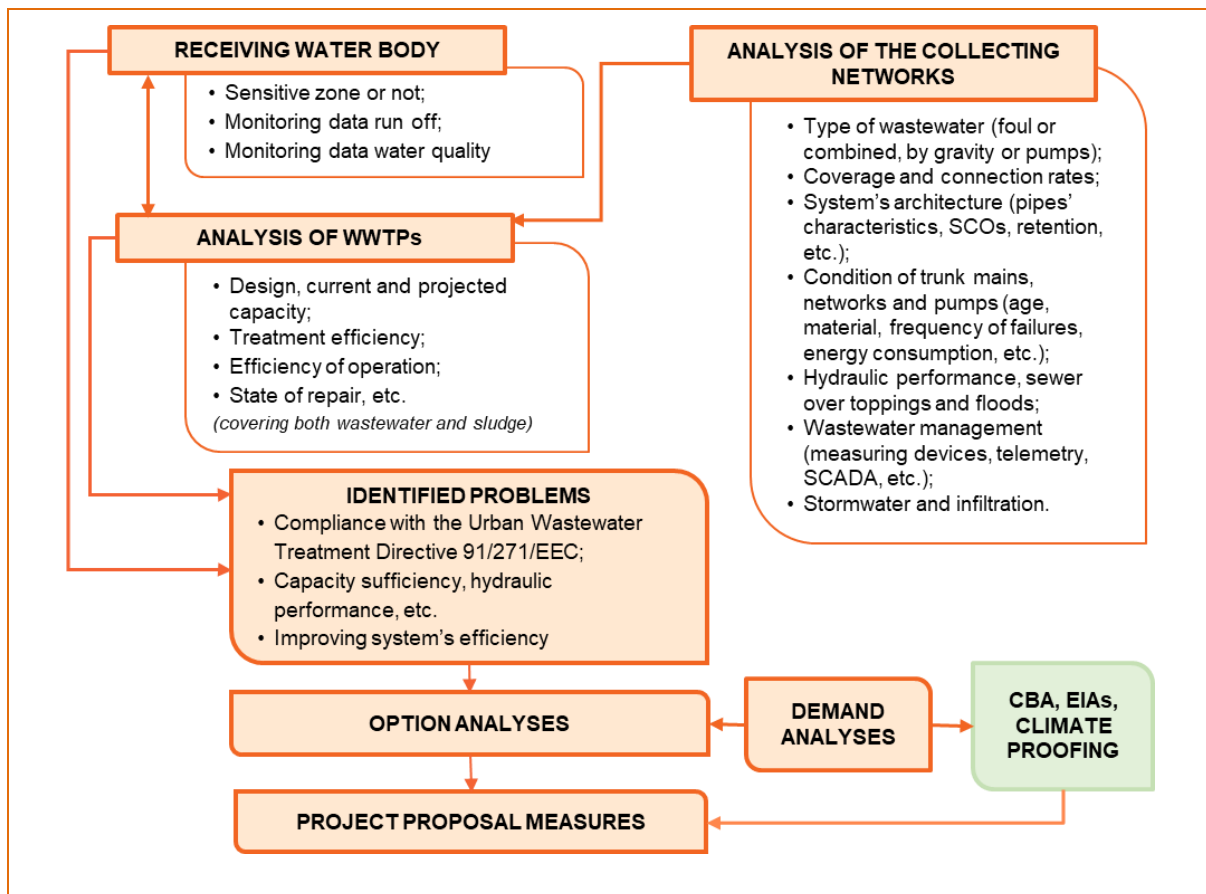


Figure 9.1: Methodological sequence in identifying project measures in wastewater

The main questions that should be answered through the analysis of the existing connection systems are:

¹¹ The European Union's Urban Wastewater Treatment Directive 91/271/ECC currently in force is more than 30 years old. This Directive is under review and a new updated Directive will be published by the European Union. More information can be found on: Urban wastewater (europa.eu)

- Are changes in the agglomeration boundaries necessary?
- What the connection rate is? Are there Urban Wastewater Treatment Directive 91/271/ECC compliance problems? Are extensions needed?
- Is there need of rehabilitation (high infiltration, flooding, Combined Sewer Overflows problems, energy efficiency pumping stations etc.)

The main questions that should be answered through the analysis of the existing Wastewater Treatment Plants are:

- Are there compliance problems regarding the quality of the discharged treated effluent?
- Are there problems with the performance efficiency of the Wastewater Treatment Plants - high operational costs, energy inefficiency, capacity insufficiency, etc.? Are there any potentials for reuse?
- Are there problems with the sludge treatment? Are there any problems with the sludge end route? Are there any potentials for reuse?
- Is the state of the construction of the facilities safe?
- How the projected change of the wastewater quality and quantity will affect the treatment performance?

The answers to these questions will facilitate identification of the major problems/drawbacks of the connection system and the Wastewater Treatment Plants. These problems should be prioritised using transparent and relevant criteria. Afterwards, for the selected problems option analysis of viable engineering options should be performed. The selected project measures (selected options) should be finally analysed in regard to their cost-benefit ratio where relevant.

Municipal wastewater sludge:

Sludge generation is an inevitable product of wastewater treatment. Both sludge treatment and the final sludge end (reuse) route should always be integrated in wastewater management planning.

9.2 Collection Systems

This section will present some major considerations when existing collecting systems are the subject of the Holistic Feasibility Study because they are a more complicated investment case than construction of a new collecting system.

9.2.1 Analysis of the existing situation

The analysis of the current state of the existing collecting systems should contain as a minimum three major blocks: definition of agglomeration boundaries, clarification of the connection rate and analysis of the engineering infrastructure (network, Combined Sewer Overflows (CSOs), pumping stations, etc.).

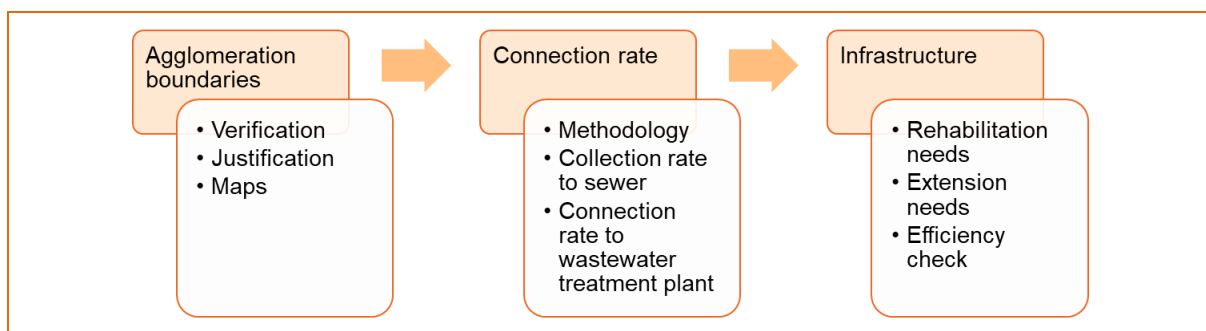


Figure 9.2: Steps when performing the analysis of the existing situation

Agglomeration boundaries

The existing agglomeration boundaries should be verified not only by desk studies but also by site inspections. The Urban Wastewater Treatment Directive's principle of "sufficiently concentrated" should be the principal consideration in the verification of agglomeration boundaries.

Justification of the defined agglomeration boundaries should be presented in a concise way; preferably by using tables with summarised data and maps than narrative means.

The boundaries of the agglomeration should be finally presented in a map, where neighbouring settlements/agglomerations and existing Wastewater Treatment Plants should be visible.

9.2.1.1 Collection rate to sewer and connection rate to Wastewater Treatment Plant

Both the rate to the collection rate to the sewer system and the connection rate to the Wastewater Treatment Plant should be determined. If these connection rates are different, there should be an explanation.

The methodology for calculation of the collection/connection rates should be well presented. Providing only numbers/percent is not sufficient. (see also Chapter 5: Demand Analysis)

Maps or schemes of the collected/connected and non-collected/connected areas should also be presented.

9.2.1.2 Engineering infrastructure

Each component of the engineering infrastructure should be thoroughly analysed: Network, Combined Sewer Overflows, Pumping stations, etc. The purpose is to understand whether the system: (i) has issues – such as insufficient capacity (flooding) or blockages or dry weather overflow from Combined Sewer Overflows, etc. and/or (ii) works efficiently (reasonable infiltration rate, non-excessive overflow from Combined Sewer Overflows, good energy efficiency of the pumps, etc.).

Information, such as the lengths of the pipes, their diameters and materials, year of construction/reconstruction, should be provided. However, this information is basic. To analyse the system well, much more should be done. For example:

- If there is ongoing project in regard to extension or rehabilitation of the collecting system, its impact should be well quantified;
- If flooding due to spills from the collecting system is an issue - maps with flooded areas and frequency of the floods should be presented; the rainfall intensities during these events should be clarified, the hydraulic conductivity should be checked (using CCTV inspection); hydraulic modelling of the system should be done using realistic scenarios based on past events. Last, but not the least, infiltration rate should be clarified. The remediation measure is not always replacement with bigger pipes, for example, "Sustainable Urban Drainage" means should be analysed (green roofs, stormwater retention or disconnection, permeable parking lots, permeable pavements, etc.). This requires information about the urbanization details of the area to be also provided.
- If poor condition of the collecting system is claimed - there should be clear identification on what needs to be replaced and why (CCTV, infiltration, blockages).
- If Combined Sewer Overflows do not work properly - thorough analysis for the reason, based on surveys and/or measurements.
- Discharge locations from Wastewater Treatment Plants (and Combined Sewer Overflows) need to show that the water bodies can deal with the discharge parameters during all seasons – these should be checked before the option is assessed. Are there any environmental or ownership issues with the Wastewater Treatment Plant location or the route of discharge pipes?

- Irregular sewers / privately constructed sewers - they can be a problem that must be addressed in the Holistic Feasibility Study. Some collection networks are considered sub-standard by the Service Providers and have not been adopted in their operation and maintenance. As an element of the Project with Holistic Approach, it can be necessary to decide the fate of this pipework.
- The reluctance of some adjacent householders to connect to existing collection systems, in particular to recent extensions to the collection networks can be an issue. The Water Service Provider could investigate options and recommend a strategy for encouragement of these residents to connect to the systems.
- Monitoring system;
- When assessing long pumped rising mains, the risk of septicity and mitigation measures should be looked at critically. The risk of water-hammer and remedial measures to mitigate against it should also be analysed.

Calculation/estimation of the flow in collection networks is always difficult, but even more so in situations of uncontrolled overflows and infiltration. Infiltration is an issue for all collection systems, particularly old ones, or ones that cross below rivers. The methodology of estimation of infiltration should be presented.

9.3 Wastewater Treatment

This section will present some major considerations when existing Wastewater Treatment Plants are subject of the Holistic Feasibility Study being the more complicated investment case than construction of a new Wastewater Treatment Plant. The number of the existing Wastewater Treatment Plants in the region does not matter; the analysis will be the same for each of the Wastewater Treatment Plants.

9.3.1 Analysis of the existing situation

9.3.1.1 Receiving water bodies

The aim of analysing the receiving water body is to verify that the Wastewater Treatment Plant discharge does not negatively impact the quality, self-purification capacity or run-off of the water body. Seasonal, as well as annual variations should be included in the analysis.

The prognoses of climate change scenarios in the region and the expected effect on the water bodies should also be considered.

The analyses of water bodies should reach sound conclusions on the following:

- Ratio of the Wastewater Treatment Plant effluent to river run-off;
- The need for more stringent treatment considering the vulnerability of water body towards climate change.

The following database could be collected and analysed:

- Data on water body quality before and after Wastewater Treatment Plant discharge for at least 5-year period;
- Data on river run-off: long time series to determine min, max and average values (if the receiving water body is a river).

Potential sources of information: The River Basin Directorates, the Service Provider, Ministry of Environment (or similar).

9.3.1.2 Analysis of Wastewater Treatment Plants

The analyses of the Wastewater Treatment Plant should reach sound conclusions on the following:

- Whether the performance of the existing Wastewater Treatment Plant is satisfactory concerning the quality of treated wastewater;
- Whether the capacity of the existing Wastewater Treatment Plant is sufficient considering the projected changes in the collecting system;
- Whether the Wastewater Treatment Plant operation is efficient and according to the best practices;

The figure below visualizes the three main groups of analyses, which should be performed in the Holistic Feasibility Study.

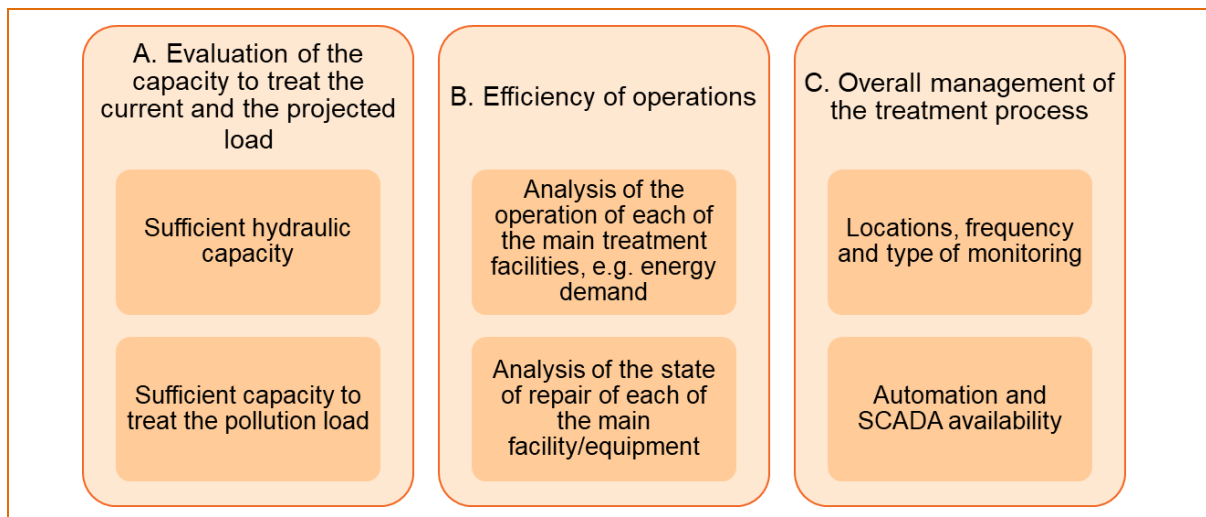


Figure 9.3: Three groups of analyses of the Wastewater Treatment Plant

These three groups of analyses are discussed in more details below.

A. Evaluation of the capacity of the Wastewater Treatment Plant to treat the current and projected load of the serviced collecting systems

Different data should be provided and analysed:

- 1) Design characteristics of the Wastewater Treatment Plant
- 2) Main polluters
- 3) The impact of the collecting system
- 4) Monitoring data at Wastewater Treatment Plant inlet
- 5) Monitoring data at Wastewater Treatment Plant outlet

All detailed data should be presented in the annexes. A summary table(s) and or charts should be presented in the main body of the Holistic Feasibility Study, indicating clearly the number of the monitored years, the number of samples, maximum, minimum, mean average values. The deviations should be explained. The reasons for inconsistency with the design values (if any) should be provided. The failures to achieve compliance with the requirements in the discharge permission should also be discussed.

If a new treatment stage/facility will be constructed/installed, all additional data on quantity and quality that are necessary to perform a correct design should also be collected and analysed.

In case of insufficient existing data, own measurement should be performed.

B. Efficiency of the operation of the treatment facilities

This analysis should outline the drawbacks of the individual treatment stages and the measures that need to be undertaken to improve the efficiency of operation, e.g. energy and/or reagent use. The evaluation should use as much as possible criteria of good engineering practices which are quantitative

and can be measured. Special attention should be given to treatment stages and facilities that will be subject to project measures. The improvement of the efficiency of operation should be justifiable.

Analysis of the state of repair of each of the main facility/equipment should also be presented.

c. Overall management of the treatment process

The type, location and frequency of the monitoring of the main parameters in the wastewater treatment process should be presented and analysed in regard to the need of upgrade/extension/modification. The SCADA system (if available) should also be analysed.

9.4 Sludge Management

Sludge Management is an integral part of the whole wastewater management process.

Sludge is an inevitable product of wastewater treatment. **Sludge generation** (quantity and quality) depends on the whole wastewater management process (type of the collecting system, connected people and industries, wastewater treatment process and sludge treatment process). The final **sludge end routes** depend on the local conditions. This two-way dependence should be well considered in development of the sludge management strategy, in particular in determining of the necessary investment measures.

9.4.1 Analysis of the Existing Situation

The analysis of the current state aims to clarify:

- Quantity and quality of the generated sludge;
- Current sludge utilisation practice: strengths and weaknesses;
- How the development of the agglomeration as well as proposed investment measures in the collecting system and Wastewater Treatment Plant will affect sludge generation (quantity and quality);
- Are investments necessary to ensure sustainable sludge management in the project time horizon.

There are three major pillars, which determine sludge management - sludge quantity, sludge quality and local conditions (opportunities) for sludge utilisation. They are briefly discussed below.

If the existing database is incomplete, own measurements should be planned to collect the necessary data.

9.4.1.1 Sludge Quantity

To analyse the quantitative parameters various data should be collected as visualised in the figure below. The completeness of this database is the foundation for correct conclusions. The more data collected and analysed, the higher the certainty of the proposed investment will be.

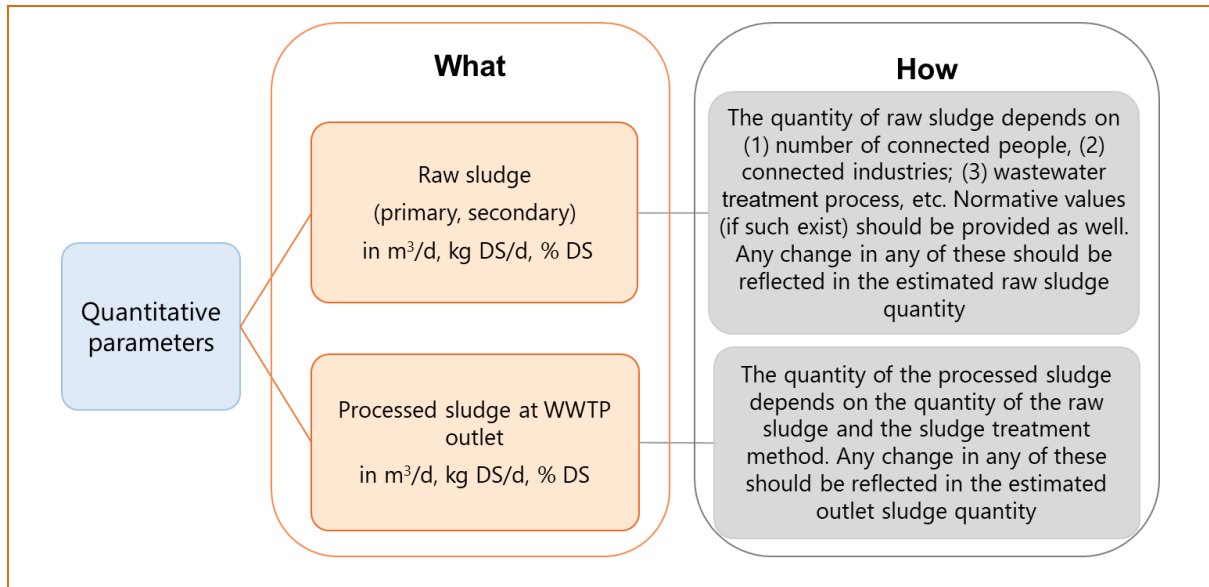


Figure 9.4.1: Visualisation of the quantitative parameters, which should be considered

9.4.1.2 Sludge Quality

Sludge utilisation depends on the appropriateness of the sludge quality for a particular option. For example, sludge containing heavy metals is not appropriate for utilisation for agricultural purposes. The figure below summarises the main factors, which should be considered as well as the way this should be done.

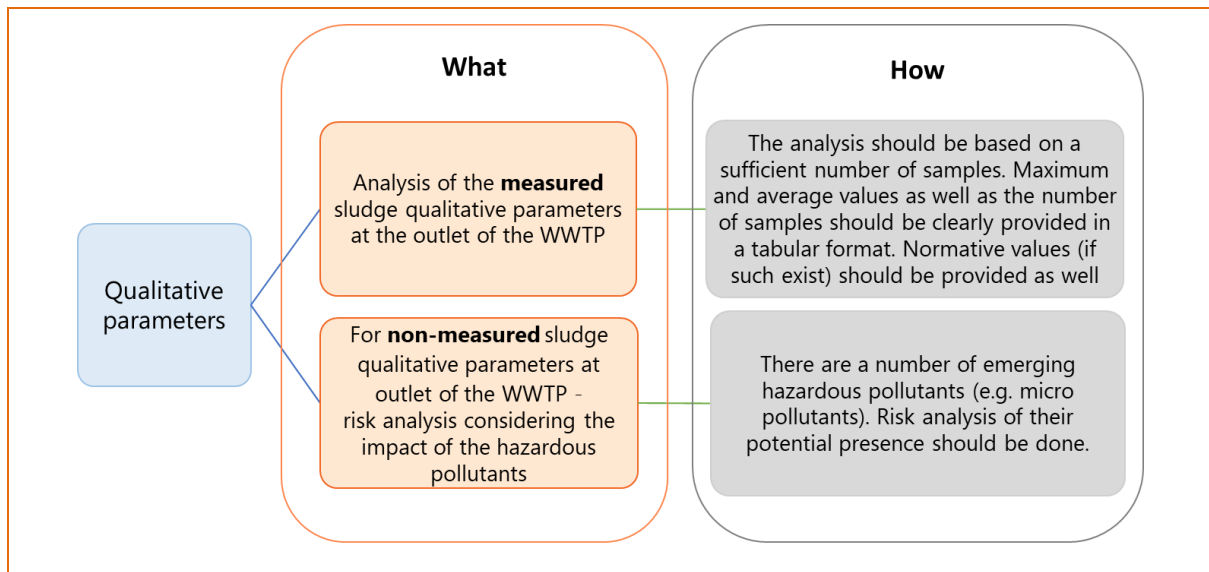


Figure 9.4.2: Visualisation of the qualitative parameters, which should be considered

Emerging contaminants have recently become major concern for human and environmental health. Often, they are “moved” from wastewater to sludge during the wastewater treatment process. Some of them are not regularly monitored. Thus, depending on the suggested sludge utilization method, the relevant pollutants should be analysed to ensure that there will not be a high risk for people or environment.

9.4.1.3 Local Conditions (opportunities) for Sludge Utilisation

Different sludge utilisation routes could be as shown in the figure below.

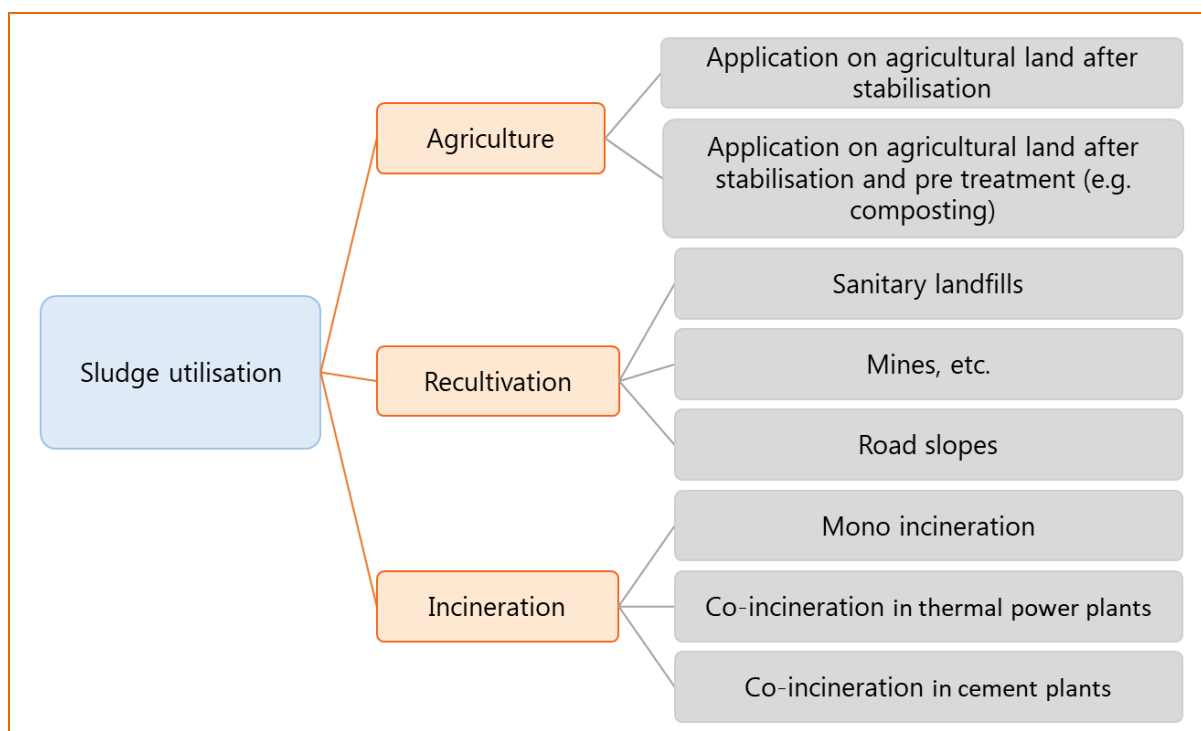


Figure 9.4.3: Example sludge end routes

The analysis of the current state should consider which of them are relevant given the particular local conditions. Please, note that the figure above is not exhaustive.

10. Holistic project investment application

Applying for funding will require the submission of an application with a list of supporting documentation (Feasibility Study, Cost Benefit Analysis, environmental studies and decisions, climate change studies, permits etc). The requirements and the final list of documents will be defined in the 'Call for Proposal' launched by MA PEKA & POLPRO.

The contents expected to be covered in the application and supporting documents are amongst other:

1	Project Context,	Description of the situation of the Water Service Provider (beneficiary), previous project programmes etc.
2	Project Objectives	Description of the main project objectives
3	Existing Situation	Analysis of the existing situation and problems/issues to be addressed by the project
4	Demand Analysis	Detailed analysis of the project demand
5	Option Analysis	Analysis of strategic and detailed options with demonstration that the most cost efficient option has been selected
6	Technical Aspects	Detailed presentation of the technical solution selected

7	Project Costs	Cost Analysis of the project
8	Financial and Economic Analysis	Detailed Financial and Economic Analysis with projections on the project Sustainability analysis of the Project and the Water Service Provider (beneficiary)
9	Financing Plan	Sources of financing and projections
10	State Aid	Analysis of any state aid considerations if applicable
11	Institutional Capacity and Capability	Institutional Framework and demonstration of the capacities of the Water Service Provider (beneficiary)
12	Climate Change	Climate proofing document
13	Environmental Impact	Environmental Impact Assessment, Appropriate Assessment, assessment for compliance with the Water Framework Directive
14	Procurement and Implementation Schedule	Time frame of implementation
15	Risk Assessment	Analysis of all relevant project risks
16	Application Form	Application Form According to National Regulation

11. Criteria and evaluation of the Water Service Provider's project proposal

The table below contains a list of possible criteria for the evaluation of the call. The list is non exhaustive and a proposal to be amended with a view to the Greek legal and institutional setting.

When referring to 'the project' below this means the investments prioritised and grouped into one project funding application under the Programme 2021-2027.

No	Criteria
1	Project Location (in line with the locations intended in the call/part of the list of Water Service Providers (beneficiary) invited)
2	Project maturity - construction on actual project has begun; - public procurement procedures have been conducted and contracts have been signed; - the project has building permit issued; - the project has technical / detailed design / tender documents;

No	Criteria
3	Implementation Schedule (Compliance of the Implementation Schedule with the deadlines of the Operational Programme)
4	Holistic Approach - the project is based on a holistic approach, i.e. provides total solutions for the water cycle of the agglomeration (Water Treatment, Water supply, Wastewater Collection, Wastewater Treatment, Sludge management); - the project investments put forward for funding has been prioritised from the long investment list based on transparent and sound criteria.
5	Documentation sufficient and in line with the requirements of documentation outlined in the call (including list in the chapter above)
6	Compliance with horizontal principles (if applicable as per requirements in Greek context) the project demonstrates compliance with the horizontal principles e.g. • Sustainable development; • Equal opportunities;
7	Relative efficiency for reaching the Operational Programme objectives <i>(e.g. the project cost divided into the real population that will be connected to the urban Wastewater Treatment Plant as a result of the project implementation)</i>
8	Scale of the project and benefits to the environment <i>(e.g. population supplied with drinking water, number of population equivalent and population connected to wastewater collection and wastewater treatment/receiving improved services, water loss reduction)</i>
9	Achieving compliance with the legislation - by implementing the project full compliance will be achieved with the relevant Directives (drinking water supply, wastewater collection and treatment (including tertiary treatment where necessary), sustainable sludge management);

No	Criteria
10	Regional significance of the project - The project considers regional dimension – the project documentation discusses regional aspects and the possibilities for the project to resolve the problems of more than one agglomeration and chooses the most economically and technologically viable solution; - The project is concerned with only one agglomeration and the project documentation does not discuss or reflect the regional dimension; - The project is concerned with only a part of an agglomeration and there is not regional effect or significance;
11	Compliance with existing investment and strategic programs and plans - The project complies with the River Basin Management Plan - The project complies with the National Drinking Water Operational Plan - The project complies with the National Operational Plan for urban wastewater management - The project complies with the National Energy and Climate Plan (NECP) - The project complies with an approved regional master plans - The project is envisaged in the district/regional development plan - The project is envisaged in the municipal development plan or the municipal services master plan - Project supplements the investment program of the Water Service Provider - any other programs and plans
12	Affordability - The tariff is below the affordability level e.g. considering the average income per capita;
13	Ability of the Water Service Provider to co-finance the project (<i>funding of the project other than grant</i>)
14	Sustainability of the Water Service Provider demonstrated (as demonstrated in the Cost Benefit Analysis)
15	Sustainability of the Project demonstrated (as demonstrated in the Cost Benefit Analysis)
16	Adequate Economic rate of return of the project demonstrated (as demonstrated in the Cost Benefit Analysis)

No	Criteria
17	Compliance with environmental and climate change policies and objectives
18	Compliance with horizontal principles: energy efficiency first (EE1st) and Do No Significant Harm (DNSH)
19	Compliance with EU environmental legislation: compliance with the Revised EIA Directive, Habitats and Birds Directives (where applicable), Water Framework Directive and other relevant EU environmental directives (Drinking Water Directive (recast), Urban Wastewater Treatment Directive, Floods Directive, Sludge Directive, Reuse Regulation, Waste Framework Directive, etc.)
20	Compliance and contribution to the Paris agreement: climate change mitigation and compatibility with the decarbonisation pathways and climate change adaptation (project resilience to climate change)