

# Water Reuse Investment Evaluation Toolkit

**A4.1:** A guide on the evaluation of water reuse investments for regions promoting water efficiency.

April 2021



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## Introduction

### 0.1 AQUARES Framework

The international AQUARES Project, which is co-financed by European Union funds under the Interreg Europe Program, was launched in the beginning of June 2018 by the General Directorate of Water, Agriculture, Livestock and Fisheries of the Regional Government of Murcia (Spain) as a lead partner of the project. Apart from the Region of Murcia the project is also composed by representatives from Greece, Poland, Malta, Italy, Germany, Lithuania, Slovenia, and Czech Republic.

The AQUARES Project focuses on the advancement of water reuse policies to promote resources efficiency and it will increase the ability of public authorities to propose legislative changes concerning the water and drinking water framework directives. The project also puts emphasis on best practices to ensure compliance with water quality standards and promotes the adoption of sustainable development and eco-innovation in agriculture, industry, urban and recreational areas. Additionally, the project draws on the experience of partner countries through the adoption of technological and managerial innovations in water reuse in various sectors.

Water reuse is a keyway to both **promote resource efficiency** in water scarce areas of Europe, and to profit from opportunities in the expanding water market, thereby alleviating pressure on wetlands and littoral areas of Europe. The EC "Strategic Implementation Plan of the European Innovation Partnership on Water", was set in place to promote and support efficient water management in Europe where **water scarcity** affects 11% of its population. In this context, AQUARES will support public authorities to initiate efforts, join forces and exchange experiences to:

- a) identify viable **strategies** to utilise water reuse to confront inefficient uses of water,
- b) make the most of **EU financing tools**,
- c) promote **public dialogue** to address conflicting interests.

The project is implemented in two phases. In the first phase of the project (from 2018 to 2020), key project activities will be implemented. From 2021 to 2022, in the second verification phase of the project, these proposed improvements will be tested and monitored by target group representatives. The AQUARES project consortium partners will not only monitor, and test identified water reuse practices in the second phase but will also inform the relevant European institutions about the implementation and usefulness of project results. The AQUARES project is 85% co-funded by the European Union under the Interreg Europe Program.

## 0.2 AQUARES Objectives

The objective of the AQUARES project is to improve policy instruments and water management concepts by integrating wastewater reuse into national, regional, and local development plans to promote the efficient management of water in EU regions. Additionally, to support sustainable development and eco-innovation across the agriculture, industrial, urban, and recreational sectors as well as improve the overall efficiency of water supply, distribution, and treatment.

In this context, the AQUARES objectives consists of the following objectives:

- Support public authorities to plan and support the utilisation of untapped water resources.
- Promote the adoption of water reuse technological and managerial innovations.
- Highlight the best practices for ensuring compliance with water quality standards across different sectors.

AQUARES will also increase the capacity of public authorities to implement the proposal of the soon to be revised Water Framework and Drinking Water directives.

### - **Operational objectives**

- Increase the capacity of public administrations to plan and implement policies that promote innovative technologies and business models for water reuse, to strengthen efficient water management and green growth.
- Create knowledge awareness on the benefits of water reuse and water efficiency solutions for environmental sustainability and the agricultural and industrial businesses of EU territories, with a special focus on the intensified needs of high stress countries & regions.
- Facilitate businesses and consumers integrate water reuse techniques and processes when producing or consuming goods and /or providing supplies, services and works.
- Unlock regional investments that can lead to the incentivisation and advancement of water reuse projects.
- Improve coordination and collaboration among public administrations to promote and support the harmonisation of their policies and quality standards about water reuse.

#### - Expected Impact

AQUARES is expected to have an impact by increasing the capacity of 200 staff of public administrations to effectively support water reuse. Additionally, 10+ million€ investments will be unlocked to support projects on water efficiency and to improve the management of water bodies. Lastly, an increased awareness and consensus building among water providers, the workforce, and citizens, to support measures for water reuse (over 1000 individuals) will be achieved.

### 0.3 AQUARES Consortium and key actors

Water reuse requires policy changes among EU regions and countries because public authorities have introduced different (in scope and pace) water management practices in issues such as planning, infrastructures, and licensing. For this reason, AQUARES brings together 10 partners from 9 EU countries, to cooperate, exchange best practices, and address territorial problems such as inefficient surface and groundwater protection, adaption to climate change, flood protection, and high WEI.

#	Partner (Abbreviation)	Country
1	Regional Government of Murcia, Ministry of Water, Agriculture, Livestock and Fisheries, General Direction of Water (MURCIA-GDW)	 ES
2	Ministry of Environment and Energy, Special Secretariat for Water (SSW)	 EL
3	Lodzkie Region (LODZKIE)	 PL
4	The Regional Development Agency of the Pardubice Region (RRAPK)	 CZ
5	Energy and Water Agency (EWA)	 MT



6	Lombardy Foundation for the Environment (FLA)		IT
7	Water Board of Oldenburg and East Frisia (OOWV)		DE
8	Euro-Mediterranean Water Institute Foundation (FIEA)		ES
9	Association “Baltic Coasts” (BALTIC COASTS)		LV
10	The Municipality of Trebnje (TREBJNE)		SI

Table 1: The AQUARES Partnership

## 0.4 Setting the context - an overview of EU water reuse policy framework.

Water shortages and droughts have become increasingly concerning across the EU due to their intensified frequency and severity; 11% of the European population and 17% of the EU territory are exposed to water scarcity, with the Mediterranean region facing the hardest pressures. The two main factors linked to water scarcity are climate conditions and water demand. Water shortages can gravely affect agriculture, industry and tourism and have severe environmental impacts. Water reuse can increase the available water resources, reduce cost and lower energy demand, subject to application, and reduce eutrophication; it is, thus, of vital importance to the EU (Angelakis & Durham, 2008).

Several international organisations, including the World Health Organization (WHO) in 2006 the United Nations Environment Programme (UNEP) in 2011 and International Organization for Standardization (ISO), have developed guidelines for water reuse.

Despite the success of water reuse in various parts of the world, such as Australia, USA (California) or Israel, the practice has not been as widespread in the EU, mainly for two reasons:

- Lack of awareness by both the public and relevant actors, and Lack of a supportive and coherent policy framework for water reuse.



The EU Water Framework Directive (2000) merely lists water reuse as one of the supplementary measures which Member States may choose to adopt. The Directive introduced the progressive reduction of several substances to be considered priority for the EU in the field of water policy. The most recent list of priority substances includes 45 pollutants and establishes standards of environmental quality and maximum permissible concentration in water (Directive 2013/39/EU).

The Communication from the Commission to the European Parliament and the Council addressing the challenge of water scarcity and droughts in the European Union (2007) formed a hierarchy of solutions to address these problems and lists wastewater reuse as one of the alternative solutions.

The Communication "Blueprint to safeguard Europe's water resources" (2012) emphasised water reuse as an imperative measure to alleviate water scarcity that requires the attention of the EU. The maximisation of water reuse was set as a specific objective and the opportunity or the development of a legislative instrument for water reuse was identified.

The Communication "An EU action plan for the Circular Economy" (2015) incorporated a few actions to promote water reuse including the preparation of a legislative proposal on minimum requirements for water reuse for irrigation and groundwater recharge.

The Proposal for a Regulation of the European Parliament and of the Council on minimum requirements for water reuse was adopted in May 2018 and the feedback period closed in August of the same year. The Regulation aspires to contribute to the alleviation of water scarcity while ensuring "a high level of protection for consumers, workers and any other exposed public as well as for the environment" and provide confidence in reuse practices.

AQUARES contributes to EU 2020 strategy targets, for which water reuse is an essential part; it is one of the 5 priority areas of work of the European Innovation Partnership on Water which aims to increase the uptake of innovative water solutions by 2020.

## 0.5 AQUARES Toolkit Structure in Use

The objective of this document is to develop an online water reuse investment evaluation toolkit aiming to assist territorial authorities involved in water reuse developments projects and help territorial authorities to evaluate aspects of water such as best management practices, investments, financing, and the technologies, business models, and monitoring practices.

This online free toolkit is also designed to provide input, resources and tools for the promotion and support of water reuse projects to be included in the action plans to improve current and future policy instrument to enable safe water reuse technology and its integration into existing markets.

This document, which is part of an integrated approach, is divided in four blocks. Block 1 covers the ***Joint thematic studies and analysis***; Block 2 entails ***Stakeholders in policy learning and Public Dialogue***; Block 3 contains ***Interregional learning and Capacity building***; and Block 4 has to do with ***Policy Improvement Interactive tool***.

## Block 1. JOINT THEMATIC STUDIES AND ANALYSIS

### [1.1 Joint thematic studies and analysis & Peer review on Regional and National policies on water reuse](#)

The document linked, aims to develop a methodology for the comparative analysis of existing water reuse policies in Partner Countries participating in the AQUARES Project of the Interreg Europe program. The application of the methodology and the analysis of the water reuse frameworks in the AQUARES partner countries will be used for the identification of suitable criteria and standards and of best practices for reuse, to be proposed for integration into the national regulatory frameworks. The Project thus aims to promote the exchange of best practices among partner countries, to improve the implementation of regional, state and local policies and programs, promoting the efficient use of water resources and supporting sustainable practices.

The document is structured as following:

**Part A** describes the methodology developed and used for the comparative analysis of water reuse policies, which involves five main steps: Data collection, Selection of indicators, Evaluation of existing practices, Identification of best practices, and Identification of appropriate water quality criteria.

**Part B** comprises the application of the developed methodology and the comparative analysis of the water reuse legislator frameworks in the AQUARES project Partner Countries. The methodological steps of Part A are followed: Collection of the relevant data pertaining to the applicable water reuse legislative frameworks of AQUARES Partner Countries, followed by the selection of suitable indicators and the comparative analysis of these frameworks, to identify and propose best practices and the most suitable water quality criteria for water reuse.

## [1.2 Analysing AQUARES Regions needs and Opportunities on water reuse.](#)

This report presents the findings of the analysis on water reuse needs in AQUARES partners' territories. The analysis focused on territorial attributes and sketches the water consumption profile of AQUARES territories (such as water demand, water supply, wastewater services and facilities, investment, and funding), also discussing the specificities of major and water intensive economic activities to identify their water reuse potential and feasibility. The purpose of this needs analysis is to enable policy makers in partnership areas to i) comprehend the socio-economic and institutional context that could best support the proliferation of water reuse solutions, ii) establish the picture of territorial reality (state of play) on water reuse needs and pinpoint drivers and barriers to the implementation of water reuse, and iii) showcase the sectors and uses that have the largest water reuse potential. Study results indicate that the sectors with the highest water reuse potential in AQUARES territories are agriculture, manufacturing, and power production. These sectors combine significant vulnerability to water scarcity, high water consumption and wastewater generation, intensive economic activity, and substantial environmental footprint. Therefore, the use of reclaimed water could provide a viable alternative to mitigate pressures on available freshwater resources while the size of the sector can justify investments in water reuse facilities and advanced treatment methods.

The report is outlined as follows:

- **Section 2** provides basic definitions for a number of water related terms used throughout the report, to facilitate readers' understanding.
- **Section 3** presents the thematic background of the study focusing on the causes being responsible for the low uptake of water reuse solutions in partnership countries, the benefits and risks associated with water reuse, and possible sources and uses for reclaimed water.
- **Section 4** outlines the methodological framework upon the needs analysis was carried out.
- **Section 5** discusses the water usage profile of AQUARES territories, showcasing drivers and barriers to water reuse and concluding to water reuse opportunities in key economic and water intensive sectors.

- **Section 6** provides a comparative analysis of partners' territorial water conditions and consumption patterns to showcase similarities and differences.

## 1.3 Identifying and assessing current technologies in water reuse

### 1.3.1 Evaluation report on water reuse technologies and practices in AQUARES Regions

This document is an output of AQUARES Activity 1.3 “Evaluation of water reuse technologies and practices across different sectors and regions”. The purpose of the activity is to identify and assess current and future technology uses in different water reuse applications in different sectors of the economy. To this end, the evaluation will enable policymakers to identify which technological solutions work best in the field of water reuse. This is accomplished through the identification and assessment of current technology uses in different water reuse applications in different sectors of the economy, including the agricultural, industrial, urban, and recreational sectors, amongst others. The selected method of data collection for this research activity was desk research.

The key findings and conclusions drawn from the evaluation of water reuse applications include the following:

- The selection of a suitable water treatment scheme depends upon various factors and must be performed taking into consideration the specificities of each case.
- Economic considerations are central when assessing the potential of water reclamation projects. It must be stressed that the cost should be assessed in relevant terms (i.e., compared to other feasible water management alternatives).
- Decentralized water reuse technologies, available in a wide variety of options and scales, emerge as a suitable option for various uses. Furthermore, solutions have been developed to reduce operational costs in small scale applications.
- The development of water reuse policies and regulation would allow for the expansion of water reuse practices, especially for countries where such legislation is absent.

### 1.3.2 Water reuse technology application guide

This document has been produced in the context of AQUARES project, to present an application guide for water reuse technologies. The AQUARES project aims to support EU regions to achieve efficient water management through water reuse, profit from the opportunities in the water market, and secure the protection of water bodies. In this context, the project pursues the integration of water reuse in national, regional, and local development plans, promoting the efficient use and management of water, as well as sustainable development and eco-innovation adoption across the agricultural, industrial, urban, and recreational sectors.

Water scarcity and drought events are likely to be more severe and more frequent in the future due to climate change and increasing population. Over the past thirty years, droughts have dramatically increased in number and intensity in the EU and at least 11% of the European population and 17% of its territory have been affected by water scarcity to date [1]. The potential role of treated wastewater reuse as an alternative source of water supply is now well acknowledged and embedded within international, European, and national strategies. Water reuse contributes to the broader water sector which is a key component of EU eco-industrial landscape. The world water market is growing rapidly, and it is estimated to reach 1 trillion € by end of 2020.

The scope of this technology application guide is to:

- (I) Identify the best technologies to be applied in priority areas for the application of water reuse and
- (II) Provide suggestions to promote and support the application of the most appropriate water reuse technologies.

The technology application guide is structured as follows: Chapter 2 describes the benefits of water reuse along with the available wastewater treatment processes and technologies. Chapter 3 presents already successful wastewater treatment applications in AQUARES territories as well as proposed treatment technologies for their sectors/areas with higher water reuse potential. Finally, chapter 4 summarizes chapter 3 presented key information and delivers suggestions on how to promote and support the application of the most appropriate water reuse technologies in AQUARES countries.

## 1.4 Evaluation of best practices for monitoring, assessing, and ensuring compliance with water reuse standards

The objectives of this AQUARES activity are to identify best practices to monitor, assess and/or effectively ensure the compliance of i.e., water treatment plants with relevant quality standards/requirements. The activity's scope extends to the regions of the partnership and to all sectors for which water reuse requirements exist (agricultural, urban, industrial, recreational use, and aquifer recharge).

The policy goal of A 1.4 is to facilitate an exchange of experience regarding successful water reuse monitoring practices amongst the project partners. The results of A 1.4 will further provide input for the development of the partner's action plan, which aims to improve the policy instruments addressed by the project.

The aim of this evaluation report is to provide policy makers with a guideline on best practices for monitoring, assessing, and ensuring compliance with water reuse standards (WRS). For this purpose, this study is addressing the following questions:

- What are the monitoring elements that project partners' regions and countries, and other EU-28 member states use to ensure compliance with water reuse requirements?
- What is the most effective way to implement monitoring practices in the water reuse sector in AQUARES regions and countries, and other EU-28 countries?



## Block 2: Stakeholders in policy learning and Public Dialogue

### 2.1 Regional Stakeholders group meetings

The stakeholders group meetings enable participants to exchange views, identify needs, and build a sustainable collaboration for both project's phases. Stakeholders were asked to provide suggestions for the action plans, ensuring their contribution in the implementation phase. They provided input depending on the expertise, area of activities and participation in different learning activities.

#### 2.1.1 Relevance of Water Reuse to Overcome Water Scarcity and Drought

This report is one of the six required by the TOR's to "focus on what is discussed during the stakeholder's meeting held in each partnering institution". The report is meant to synthesize the main issues which emerge during discussions and highlight bottlenecks in current policy and legislation on water reuse.

#### 2.1.2 Linkage of Water Reuse with other policies

The second stakeholders meeting theme revolved around the *Linkages between water reuse policy and other sectoral policies, namely agriculture, industry, and tourism*.

This report is the second of its kind required by the Guidance Document and it synthesizes the main issues emerged during discussion of the second stakeholders' meeting, highlighting bottlenecks in current policy and legislation on water reuse. A brief synthesis will be given for each partner contribution, drawing on the minutes submitted by each partner to highlight the main issues raised by stakeholders at each partners meeting.

#### 2.1.3 Meeting: Technical Innovations for Specific Water Reuse Applications (To be included)

This third interim report includes a summary of the discussion and conclusions of the 3<sup>rd</sup> Stakeholder's Meetings held by each partner.

The theme of the third semester is *Technological Innovations for Specific Applications* and partners were invited to discuss recent progress in wastewater treatment for specific applications, namely agriculture, industry, and MAR.

2.1.4 Meeting: Socio-Economic Impact of Water Reuse Development on Agriculture and MAR – Overcoming the barriers and apprehensions of Reuse. (To be included)

2.1.5 Meeting: Financial Instruments for Cost Recovery (To be included)

## 2.2 Public Consultation meetings

The report below includes the organisation of 18 public consultation meetings with members of the public and stakeholders operating in partners' areas on issues that require broad public support/consensus.

The information provided is a compilation of different findings as presented by project partners. The overall aim of this report is to analyse and synthesise the results from the various public consultation meetings based on AQUARES partner's summary reports, to identify common issues, barriers, and enablers to measures proposed in actions plans that require consensus and to develop recommendations on how to increase awareness on the suitability of reused water.

The themes of discussion of these public consultation meetings were of A1 activities including *Comparative analysis of regional and national policies on water reuse* (A1.1), *A1.2: Analysing the needs of AQUARES regions in water reuse* (A1.2), and *Evaluation of water reuse technologies and practices across different sectors and regions* (A1.3)

## Block 3. Interregional Learning and Capacity Building

### 3.1 Interregional WS on public and private investments

This input study is one of the objectives of a call for quotations for External Support Services for the development of a "Report on unlocking Public and Private Investments in Water Reuse" issued by the Energy and Water AGENCY MALTA.

The Input Study is based on the baseline studies provided to us by the Contracting Authority and other sources identified because of desktop research. It seeks to outline the role

of financial and legal incentives at European level, while also proposing guidelines on how to setup Public–Private Partnerships.

The Input Study is based on significant desktop research into the development and application of Public-Private Partnerships, especially within the water-reuse sector, while referring to the European PPP Expertise Centre's (EPEC) guidelines on PPPs. We also consulted with key local experts in the field to ensure a high-quality deliverable.

The Input Study focuses on the following:

- Financial and legal incentives of Public–Private Partnerships at the regional level:
  - Public–Private Partnership theory and basic concepts.
  - Different Public–Private Partnership models applicable to water management.
  - Project financing - a primer to financial analysis and economics analysis.
  - Risk identification and mitigation techniques.
- Provide guidelines on how to setup public–private partnerships:
  - Shifting from theory to practice - introducing potential enablers and barriers of using public-private partnerships to achieve water efficiency.
  - Public–Private Partnership implementation and project management.
  - Case Study 1: Setting up Public–Private Partnerships relevant to water management and reuse techniques in densely populated areas within the EU.
  - Case Study 2: Setting up Public–Private Partnerships in EU areas with low natural freshwater resources.
  - Case Study 3: Setting up Public–Private Partnerships in EU areas with abundant natural freshwater resources.

### Structure of the Input Study

In line with the previously mentioned focus areas, the Input Study is structured as follows:

- A brief overview of the current water shortage situation in Europe and in Malta.
- An introduction to financing resource recovery and reuse.
- An understanding of Public–Private Partnerships.

- Public–Private Partnerships in practice.
- The European PPP market; and
- Overview of relevant case studies.

## 3.2 Interregional WS on water reuse technology and standards

### [3.2.1 Input study for the organization of the Interregional Workshop on water reuse technologies](#)

The aim of the input paper is to be used as the primary source of knowledge for the capacity building and interregional learning processes of the policy workshop.

The input paper will present to the workshop delegates the most relevant needs & challenges to be addressed through regional policies. It will also specify the organizational details of the workshop to be hosted by FLA and provide guidelines on how to prepare the workshop summary report to facilitate the integration of its results/findings into the AQUARES action plans.

The input paper is structured as follows: section 2 outlines the key activities of the AQUARES project; section 3 defines the scope of the interregional workshop; section 4 provides the thematic background, and section 5 presents the research conducted for the collection of cases of application of water reuse technologies. Section 6 provides recommendations in the form of topics to be presented and discussed in the workshop, while section 7 illustrates past events and projects. Section 8 defines the scope and objectives of the workshop, presenting organisational details such as date, duration, participants, format, and agenda. Section 8 also shows how to build upon the conclusions of the workshop.

**Summary report-** Interregional Workshop on “how to apply to the appropriate technologies to water reuse across the agricultural, industrial, urban and recreational sector of each region”.

### 3.2.2 Interregional Workshop on water reuse technologies and standards

**Input Study** with thematic and organisational guidelines for workshop on how to apply appropriate standards to water reuse.

This Input paper provides the background information in support of the interregional workshop on water reuse standards, already organised by the Water Board of Oldenburg and East Frisia (OOWV).

The main objectives of the workshop were to bring together representatives of regional and local public administrations and members of stakeholder groups to exchange experiences on how to apply the appropriate water reuse standards across the agricultural, industrial, urban and recreational sectors of each region.

The input paper is outlines as follows: Section 2 represent the added value of the projects' interregional workshops, on water reuse standards. Section 3 offers the thematic background for the interregional workshop. Section 4 outlines indicative thematic areas to be covered by the workshop along with topics for discussion. Section 5 focuses on organisational aspects for the workshop. Finally, section 6 provides instructions for drafting the workshop's summary report.

**Summary Paper** on Interregional workshop on water reuse technology and standards (FULL DOCUMENT)

### 3.3 Site Visits Exchange

**Site visits Exchange to match make desired water reuse initiative with appropriate technologies and business models.**

One of the objectives of this guideline is to be able to be used for organizing site visits exchange without previous knowledge about these topics. This paper offers exchange of 54 Best practices on water reuse identified by each partner in the influence area of AQUARES.

As for the classification of the identified best practices, the category most identified are Methods and Technologies of treatment; Applications of water reuse (agricultural, recharging aquifers,

industrial uses, leisure uses, domestic); Governance measures; Restoration of landscapes and wetlands; Valorization of wasters and recovery of N and P; Harvesting rain reuses.

A wider explanation of each of the Best Practices can be found in the Annex 1 of this report.

### [3.4 Study visits to transfer experiences on AQUARES](#)

This input paper is aimed at being a source of information describing the water reuse practice in Europe. It offers some background information on the current status in the EUROPEAN Union illustrated with some statistics, as well a water reclamation reuse and monitoring technologies and reclaimed water application in Europe.

The core part of this document is dedicated to the water reuse related case studies in Lodzkie region. The most successful water reuse stories from Lodzkie voivodeship are presented with the reference to the possible applications of the reclaimed water: public sector, industry, agriculture, sport and recreation.

### 3.5 Interregional EU-level WS for public authorities on water reuse policy

(A3.5 To be included)

## Block 4: POLICY IMPROVEMENT TRANSFERABLE TOOL AND RESOURCES

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*Help document*

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***DBToolkit version 0.3***



## 4.1 Introduction

The DBToolkit0.3.accdb database is an application that tries to provide a simple solution in the Access database, for a not specialized potential user in this kind of applications. The main objective is to interactively generate reports that can be useful to implement possible solutions to the current situation of potential users in the area of water reuse or to access examples available in AQUARES that may be related to the above said situation.

For this, a relational database has been implemented in the Access Database Management System (DBMS) that allows to relate the different contents studied in AQUARES, and a window-type environment to generate a report of the user's situation by answering four questions. The database is implemented under this technology due to its advantages over other technologies:

- The application can be used with a simple download of the file, running it locally on their own PC. This way, the user has the possibility of generating various reports, which can be kept for reuse, without the need for any type of installation.
- Its development allows the use of the most widely used DBMS in the world. Furthermore, it can be run on any PC that has Access or its free runtime installed.
- The conceptual scheme designed will allow us to scale the AQUARES interactive database to an application on a multi-user web server, with the advantage of being able to store the reports created by various users and thus be able to generate usage statistics, identify general needs of the users, etc.

In Figure 1 the conceptual design of the database is represented. It is made up of 16 entities or related tables. Seven tables (in orange color) correspond to index tables with the default information that will be incorporated into the final report. In this way, the user will create new information in the report creation form, being stored in the five tables (in blue color in Figure 1). From this information, responses are directly related to the first four index tables; These tables are related to the rest of the index tables from intermediate tables related all to all (in green color). In this way, it is possible to generate the resulting report in an automated way according to the questions answered by the user.

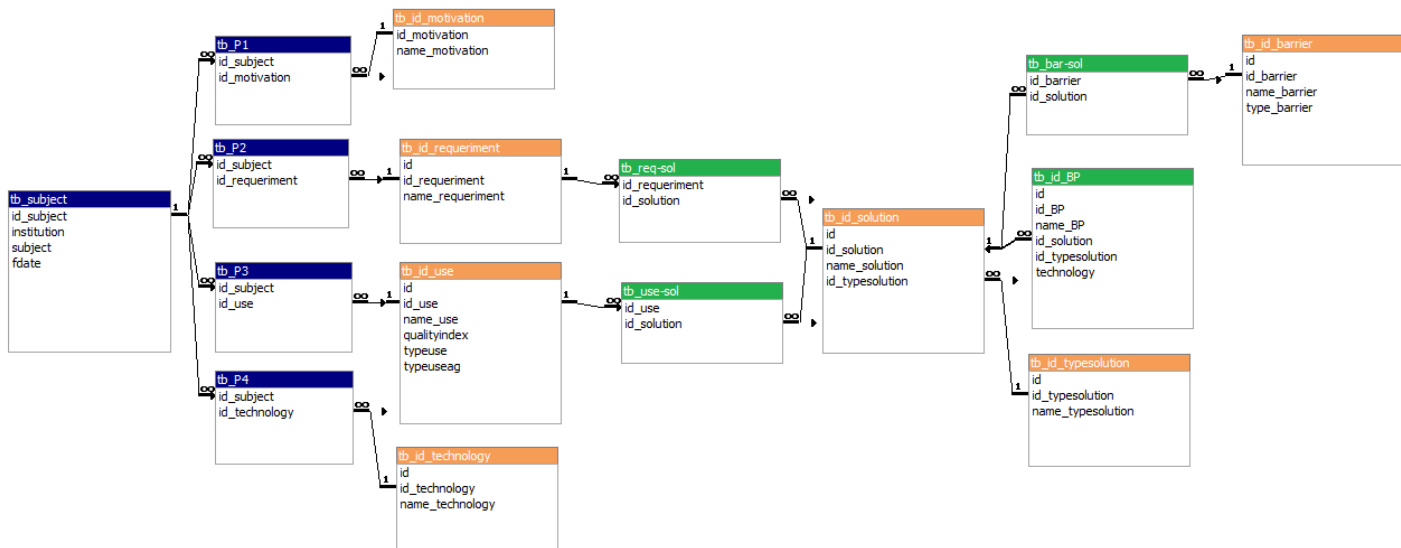


Figure 1. Conceptual design of the database. Definition of entities (tables), variables contained in them (columns) and the relationships between them.

## 4.2 Help manual

### 4.2.1 System Requirements

It is necessary to have 64 bits Access 2007 or above. However, a 32-bit version is also included for users who do not have a 64-bit Operating System (DBToolkit0.3\_32bits).

Otherwise, the Access runtime can be used, available on the Microsoft page:

- 64bits:

<https://c2rsetup.officeapps.live.com/c2r/download.aspx?ProductreleaseID=AccessRuntimeRetail&language=en-us&platform=x64>

- 32bits:

<https://c2rsetup.officeapps.live.com/c2r/download.aspx?ProductreleaseID=AccessRuntimeRetail&language=en-us&platform=x86>

Although it is not a mandatory requirement, it is also advisable to install the "[Adobe Acrobat Reader](#)" program, because the application allows the resulting report to be exported to this type of file.

In the latest versions of Windows 10, it might appear a security warning (Figure 2) the first time the file is run, due to the level of security in the execution of programs of the Operating System. In these cases, for its correct operation, you must click on the "Open" button.

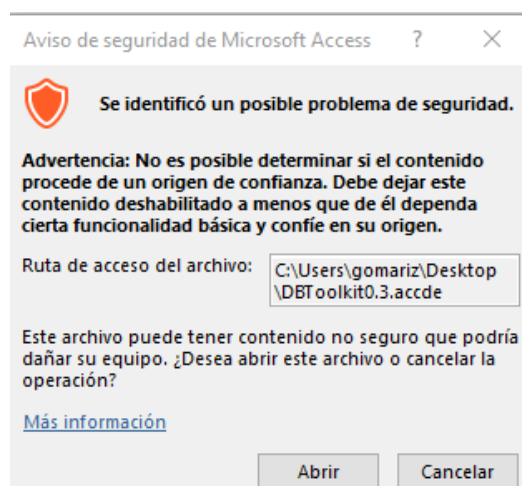




Figure 2. Windows 10 sample security warning.

### 4.2.2 Use of the Interactive AQUARES Database tool

When clicking on the file, the application will start with the main window (Figure 3). The “Add record” button  allows to generate a new report (subsection 0) by the completion of the User general information and answering four questions through the options available in the dropdown menu. To access the list view and the reports already generated, just click the “Access to created records”  button. (subsection 0).

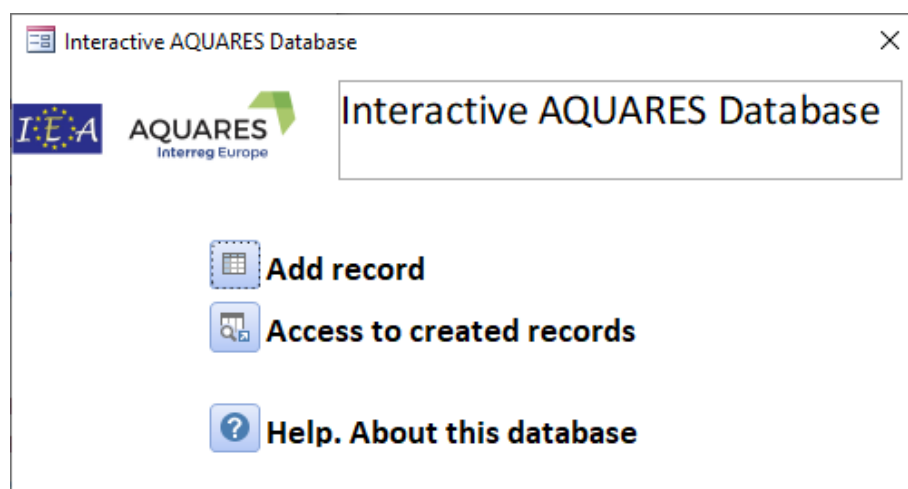



Figure 3. Main login form.

### 4.2.3 Add record

When clicking on the button  a new record introduction form starts (Figure 4), whose main objective is to create a new report associated with a specific user and date. The functionalities of the workspaces are as follows:

The screenshot shows a web application window titled 'Create new report'. At the top, there are logos for the European Union, I: E: A, and AQUARES. The main heading is 'Interactive AQUARES Database'. Below this, there are two text input fields: 'Institution:' and 'User:'. To the right of these fields is a blue button labeled 'Create report'. Above this button, there is a label 'Start report Creation button' with a downward arrow. Below the 'Create report' button, there is a large rectangular area labeled 'Generate report:'. At the bottom of this area, there are two buttons: 'VIEW REPORT' and 'EXPORT REPORT'. The form is annotated with red letters: 'a)' points to the 'Institution' and 'User' fields, 'b)' points to the 'Create report' button, 'c)' is in the center of the 'Generate report' area, and 'd)' points to the 'VIEW REPORT' and 'EXPORT REPORT' buttons. There is also an 'Exit button' in the top right corner.

Figure 4. New report creation form.

- a) General data of the new record: Information regarding the institution and user that is going to create the report.
- b) The button to generate the new report **Create report**: It starts the process of filling in the questionnaire subform (c) by the user. For that, the “Institution” and “User” text boxes must be previously filled in.
- c) Completion space: This space is enabled when clicking on the button to create a new report (Figure 5). Its objective is to allow the user to easily answer the four questions that will automatically generate the report. For that purpose, the user can select from the drop-down text boxes available with default settings. Multiple answers can be provided in each question, by clicking on the “new record” drop-

down button (see details Figure 5). In this example, the first question has been filled with two answers and the second one is being filled in. In the second question, a vertical scroll of navigation can be observed, which appears when more than three answers are given to the question. To add a new answer, the user must select “New record” and click on the drop-down button. The application also permits the elimination of an answer. For that, the record to delete must be selected first, and then the DELETE keyboard button is to be clicked, which is on the left side of the mouse (see Figure 6).

**Create new report**

**Interactive AQUARES Database**

**Institution:**  
Euro-Mediterranean Water Institute

**User:**  
Francisco Gomariz Castillo **Create report**

**Generate report:**

What is your motivation to implement measures which encourage water reuse?

Motivation	
Lack of water	
Reduction of discharges to water bodies	
*	

Please choose which situation or situations belong to your region

Requeriment	
Cost saving for Public Authorities	
Job creation	
<b>New record</b>	

What uses are considered as a priority in your region to benefit from reused water?

Use	
*	

Technologies to be implemented so that water is not the limiting factor for the activity of such uses

Technology	
*	

**VIEW REPORT** **EXPORT REPORT**



Figure 5: “Create report”.

Please choose which situation or situations belong to your region

Requeriment
→ Avoid the discharge to the water bodies by flash flooding episodes
Cost saving for Public Authorities
Increased Revenues for the agricultural sector

Figure 6. Example of record deletion in question 2. In this example, the first record has been selected.

d) The buttons to generate the report (see subsection 0), which will be activated next to the space for filling in; (it allows a preview and export in pdf format):

- The button “View report” : Generates the report in a continuous form as a preview.
- The button “Export report” : Exports and displays the report in a pdf format. The report will be created by default in the directory where the application is located.

#### 4.2.4. Access to created records


The main dashboard button ‘Access to created records’ opens a window to select and/or manage the reports already created in the ‘Add record’ window. An example of the record selection window is shown in Figure 6. The space “Active report tab” represents each of the reports generated. It presents information regarding the active report (Number, Date, Institution, and Subject) and the button “Delete report” . As observed in the “Navigation bar” there are two examples of reports available (the second of which is active), allowing the user to scroll through all the available reports. Once the report is active, the user can export the report by clicking the ‘View-export report’ button.



Figure 7. Select report window. The text in blue refers to the components available in it.

#### 4.2.5 Generated report

The report generated by the application has been structured in four main sections:

1. **Initial solution** (first page) (Figure 8): This section summarizes the user responses to the four questions posed, including the internal code of the selected records. For the selected uses, the “Quality Index” is included, which reflects the quality code for the reuse of water defined in the Royal Decree 1620/2007 from Official State Bulletin (BOE) nº 294, 2007 ([BOE-A-2007-21092](#)). This Index serves as a reference to access ‘Annex I.A.: Quality criteria for water reuse depending on its usage’, whereby the required quality values are specified.

**Interactive AQUARES Database**

**Date:** 08/04/2021

**Institution:**

**Subject:**

---

**1. Initial situation:**

**1.1. What is your motivation to implement measures which encourage water reuse?**

**1.2. Please choose which situation or situations belong to your region**

**1.3. What uses are considered as a priority in your region to benefit from reused water?**

**Type of use:**

**Quality index:**

**1.4. Technologies to be implemented so that water is not the limiting factor for the activity of such uses**

Figure 8. Initial situation: Details of the first section of the report.

2. **Solution proposal to implement based on the initial or current situation** (Figure 9):  
From the report's second page on, some possible solutions are listed to be implemented depending on the initial situation selected and the uses considered imperative.
3. **Examples included in AQUARES related to the proposed solutions** (Figure 10): It includes examples of AQUARES projects (clicking on its name, access to its main page is provided) which may be of the user's interest.
4. **Main barriers for the implementation of such measures** (Figure 11): The report generated includes possible barriers that may exist to implement the proposed solutions.
5. **Financial solutions for Water Reuse** (Figure 12): This section includes general access to the document made in the framework of AQUARES on possible solutions.

AQUARES

Interreg Europe

Interactive AQUARES Database

Date: 08/04/2021

**2. According to the initial situation, the solutions under study to implement in your region would be:**

**2.1. Based on current situation**

**N9** *Energy and carbon savings*

**Possible solutions:**

**S7** *Governance and policies to overcome the sector barriers*

**S7D** *Policies aimed at reducing energy consumption in water filtration*

**S2** *Management systems to reduce water discharges to the water bodies*

**S2C** *Collecting systems of grey water and stormwater to be treated and allocated to other urban uses*

**S3** *Technological solutions to automate processes in the water reuse cycle*

**S3C** *Administrative measures to control the polluting contribution to the process*

**S3B** *Other improvements of the treatment process*

**S3A** *Use of telemetry for a real-time control of the process*

**S4** *Water treatment technologies*

**S4G** *The MBR technology consists in providing a high quality wastewater treatment with low surplus sludge production*

**S4F** *AMBR is an aerobic wastewater treatment solution, which combines aeration with membrane bioreactor technology. It provides high quality wastewater treatment with low surplus sludge production*

**S4M** *Biogas production to reduce energy consumption*

**S4L** *Pure anaerobic treatment*

**2.2. Based on priority uses**



**U13** *Pasture irrigation for livestock consumption, providing milk or meat*

**Possible solutions:**

**S5** *Non-common uses found in the project*

**S5A** *Indirect water reuse use*

Figure 9. Second section's details: Possible solutions to implement depending on the initial situation.



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**3. The examples found in AQUARES that you might look at would be:**

**3.1. For current situation**

**S2C** *Collecting systems of grey water and stormwater to be treated and allocated to other urban uses*

Examples:

[Botanica K – system of grey waste water management](#)

[Rainwater reuse for service vehicle washing](#)

[Use of rainwater collected in the Regional Fund for Environmental Protection and Water Management](#)

[Water reuse at the building level – Condominio di via Sassetti](#)

**S3A** *Use of telemetry for a real-time control of the process*

Examples:

[New Water – Automated Distribution System](#)

[Smart Irrigation and water reused for agriculture use](#)



[Telemetry system for sewage pumping stations in Municipality of Trikala](#)

**S3B** *Other improvements of the treatment process*

Examples:

[New Water - Highly Polished Treated Effluent](#)

Figure 10. Third section's details: Examples included in the AQUARES project associated with the S2C solution.



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**4. The main barriers for the implementation of such measures would be:**

**4.1. For current situation**

**S2C** *Collecting systems of grey water and stormwater to be treated and allocated to other urban uses*

Type of barrier: *No examples have been identified for this solution yet*

B99 *No examples have been identified for this solution yet*



**4.2. For priority uses**

**S4A** *Sand Filtration (for swimming-pools and prefiltration)*

Type of barrier: *No examples have been identified for this solution yet*

B99 *No examples have been identified for this solution yet*

Figure 11. Fourth section's details: Possible barriers to implementing the identified measures.



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### 5. Financial Solutions for Water Reuse

The report offers financing solutions available to entities forming part of the European Members States, on public and private funding. The report attains to provide a response to financing strategies and main element:

- Where do the funds come from? i.e. Funding sources.
- How are funds delivered to the recipient? i.e. Resource pathways; and
- Who is the recipient, i.e. who owns and manages the wastewater treatment and recycling facilities ownership.

For more information you can access the following presentation:

[Unlocking Public and Private Investments in Water Reuse](#)

Figure 12. Fifth section's details: Financial solutions for Water Reuse.

## 5. Conclusions and recommendations

Based on the research collection performed by the partnership of AQUARES project and the results gathered from work package A1, A2, and A3 during the first stage, an online water reuse investment evaluation toolkit has been elaborated. As previously mentioned, the tool's main objective is to assist territorial authorities involved in water reuse developments projects and help territorial authorities to evaluate aspects of water such as best management practices, investments, financing, and the technologies, business models, and monitoring practices.

The technologies described range from mature technologies, such as the combination of physical-chemical systems, primary sedimentation, disinfection technologies, activated sludge and sand filtration used in the wastewater treatment plants of the region of Murcia, to innovative approaches, such as the combination of nanoremediation.

The selection of a suitable water treatment scheme depends upon a number of factors, including the **location, the quality of the input water and the desired quality of the output water**, and thus must be performed taking into consideration the specificities of each case. Nevertheless, the majority of the technology combinations examined is transferable to other settings.

**Economic considerations** are highly significant when assessing the potential of water reclamation projects. When assessing the economic impact of a water reuse project one needs to assess the cost in relevant terms, by comparing the costs of the water reuse project at hand to the costs of other feasible water management alternatives and the cost of not pursuing any water management changes.

In terms of the durability of results, certain aspects and recommendations could be considered as follows:

- **Usability and Reproducibility:** One of the objectives of implementing the toolkit is that it can be used and reproduced in other types of related work, modifying the information included in the index tables.

- Expansion of available records: Currently, the database is in the process of expanding and updating the index tables. There is a possibility to keep expanding the stored records from the database.

- Scalability: Similarly, compared to the individual use of the current tool, its scalability has been planned to a web application that has a) an access portal (like the new registration window in the database) to users interested in it and b) a database stored in a corporate Database Management System (for example, PostgreSQL). In this way, it is possible to use the application centrally and store the records created and as well as analyse the information stored to know different aspects such as summary statistics, etc.