ADVISORY SERVICES AGREEMENT ON
TECHNICAL SUPPORT TO ROMANIA IN ANALYZING AND ADDRESSING THE CHALLENGES IN MEETING THE UWWTD REQUIREMENTS (P167925)

Output No. 2

Report on options for optimization of compliance costs and implementation status of UWWTD, including methodology for defining agglomeration with more than 2,000 p.e.

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Copyright Statement

Purpose

This report has been delivered under the Advisory Services Agreement on Technical Support to Romania in Analyzing and Addressing the Challenges in Meeting the UWWTD requirements signed between the Ministry of Environment, Waters and Forests and the International Bank for Reconstruction and Development on January 28, 2019. It corresponds to Output 2 under the above-mentioned agreement.

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Table of Contents

List of Tables

List of Figures

Abbreviations

AdP	Águas de Portugal
ANAR	National Administration "Romanian Waters"
ANCPI	National Agency for Cadaster and Land Registration
ANRSC	National Regulatory Authority on Communal Services of Public Utilities
ARA	Romanian Water Association
BOD_5	5-day Biochemical Oxygen Demand
CAPEX	Capital Expenditure
CEN	European Committee for Standardization
CIP	Capacity Improvement Plan
CLC	CORINE Land Cover
CNA	Capacity Needs Assessment
CS	Collecting System
DBO	Design-Build-Operate
DG Regio	Directorate-General for Regional and Urban Policy
EBRD	European Bank for Reconstruction and Development
EC	European Commission
EEA	European Environmental Agency
EIB	European Investment Bank
EPAL	WSS Operator for Lisbon Area
EPNAC	Evaluation of New Sanitation Processes for Small and Medium-sized Communities
ERSAR	national economic regulator for drinking water supply
ESIF	European Structural and Investment Funds
EU	European Union
FM	Financial Model
FS	Feasibility Studies
GD	Government Decision
GIS	Geographic Information Systems
GoR	Government of Romania
IAS	Individual or Other Appropriate Systems
IDAs	Intercommunity Development Associations
IFIs	International Financial Institutions
INHGA	National Institute of Hydrology and Water Management
IP	Implementation Plan

IRSTEA	National Research Institute of Science and Technology for Environment and Agriculture
ISPA	Structural Pre-Accession Instrument
LAU	Local Administrative Units
LIOP	Large Infrastructure Operational Programme
LOC	Local Operating Company
LPAs	Local Public Administration
MARD	Ministry of Agriculture and Rural Development
MEF	Ministry of European Funds
MoH	Ministry of Health
MEWF	Ministry of Environment, Waters and Forests
MPF	Ministry of Public Finances
MPW	Ministry of Public Works
MRDPA	Ministry of Regional Development, Public Administration
MS	Member States
NIP	National Implementation Program
NPLD	National Program for Local Development
NPV	Net Present Value
NRDP	National Rural Development Program
O&M	Operation and Maintenance
OP	Operational Programme
OPE	Operational Programme – Environment
OPEX	Operational Expenditure
P.E.	Population Equivalent
PCC	Project Co-ordination Committee
PMC	Project Ministerial Committee
PPP	Public-Private Partnerships
PUG	General Urban Plan
PUZ	Zonal Urban Plan
PV	Present Value
RAS	Reimbursable Advisory Services
RBA	River Basin Administrations
RBD	River Basin Directorate
ROC	Regional Operating Company
SAPARD	Special Accession Programme for Agricultural and Rural Development
SDGs	Sustainable Development Goals
SFP	Strategic Financing Plan

SIIF	Structured Implementation and Information Framework
SOP	Sectoral Operational Program
TA	Technical Assistance
UN	United Nations
UWWTD	Urban Waste Water Treatment Directive
UWWTP	Urban Wastewater Treatment Plant
WB	World Bank
WBAs	River Basin Administrations
WFD	Water Framework Directive
WICS	Water Industry Commission of Scotland
WSS	Water Supply and Sanitation
WW	Wastewater
WWM	Wastewater Management

Chapter 1. Introduction

PURPOSE

1. This Report on options for optimization of compliance costs and implementation status of UWWTD, including methodology for defining agglomeration with more than 2,000 p.e. represents the second output specified in the Reimbursable Advisory Services Agreement (RAS) signed between the Ministry of Environment, Waters and Forests (MEWF) and the World Bank (WB) on January 28, 2019 to provide "Technical support to Romania in analyzing and addressing the challenges in meeting the UWWTD requirements". The Report describes proposed methodologies for delineation of agglomeration boundaries and calculation of their pollution load, options for IAS and an adequate process to ensure that they provide the required "same level of environmental protection". It also presents European Union Member States experience on Urban Waste Water Treatment Directive (UWWTD) implementation and lessons to be learned.

SCOPE

2. As mentioned above, the scope of the Report is to enable Romanian Government to review options for optimization of compliance costs for achieving compliance with the UWWTD and more specifically addressing the technical tasks assigned to the WB team to support the review and update of agglomerations with more than 2,000 p.e. and preparation of updated list of agglomerations above 2,000 p.e. details and maps based on proposals for optimizing cost of compliance with the UWWTD. The first step in delivering on this is the development of methodologies for delineation of agglomeration boundaries and calculation of their pollution load in line with the UWWTD and some preliminary results of their implementation in Brasov county.

   The analysis, carried out during the inception phase of this assignment, showed that although not compliant, a considerable number of agglomerations have partial coverage with centralized collecting systems (**Table 1**).

Table 1 Availability of collecting system as at the end of 2017

	Agglomerations*	**Population****		**With partial or completed collecting systems***	
	number	number	%	number	%
Above 10,000 p.e.	207	8,321,501	77	202	97
Between 2,000 -10,000 p.e.	1,663	2,513,710	23	689	41
Total	**1,870**	**10,835,211**		**891**	**47**

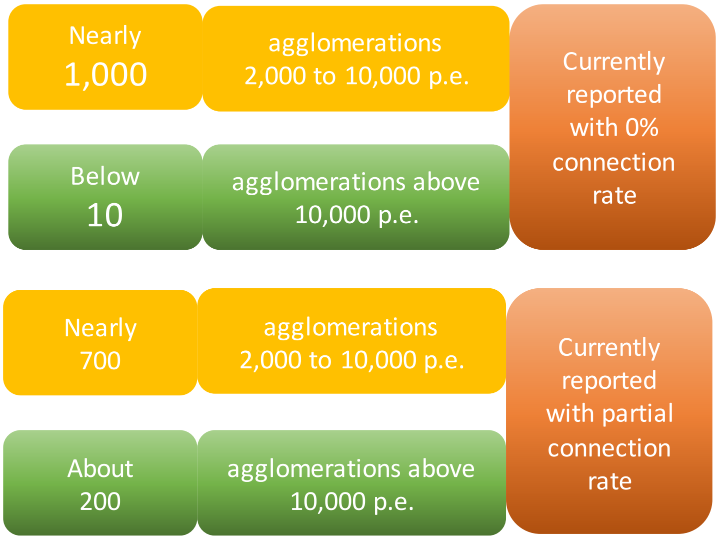
**Provided by ANAR (Raport ape uzate sem II 2017_final)*
***WB calculations based on 2011 census and NSI data for 2017 population by counties*

Three important observations could be made:

- The number of small agglomerations (between 2,000 and 10,000 p.e.) is much higher than the number of bigger agglomerations (above 10,000 p.e.);
- The percentage of small agglomerations without any collecting system is extremely high and not comparable to any other European Union (EU) member state;
- The population living in small agglomerations is a big percentage from the total population compared to other EU member states.

Figure 1 indicates where the efforts of the Romanian Government should focus to accelerate compliance. It could be summarized that following the initial stocktaking analysis of the WSS sector, this Report is presenting solutions and options for optimization of UWWTD compliance costs based on new inventory of agglomerations in the country, which if implemented would lead to a better application of EU requirements, while saving investment and operations costs, as well as reducing potential infringement penalties to Romania.

Figure 1: Current status and potential prioritization of actions



Source: ANAR list of agglomerations, 2017

REPORT OVERVIEW

3. This Report has the following structure:

Chapter 1. of the report describes the scope, purpose and provides an overview.

Chapter 2. presents the methodology for delineation of boundaries in agglomerations with more than 2,000 p.e. It describes the requirements at EU and national level regarding collection and treatment of wastewater; the objective and proposed methodological approach; the determination of cut-off values for Romania and demonstration of methodology application .

Chapter 3. describes the methodology for calculation of agglomeration pollution load. The objectives and approach are presented, as well as the assumptions, required information and equations that will enable the team to implement the methodology and recalculate the pollution load within agglomeration boundaries.

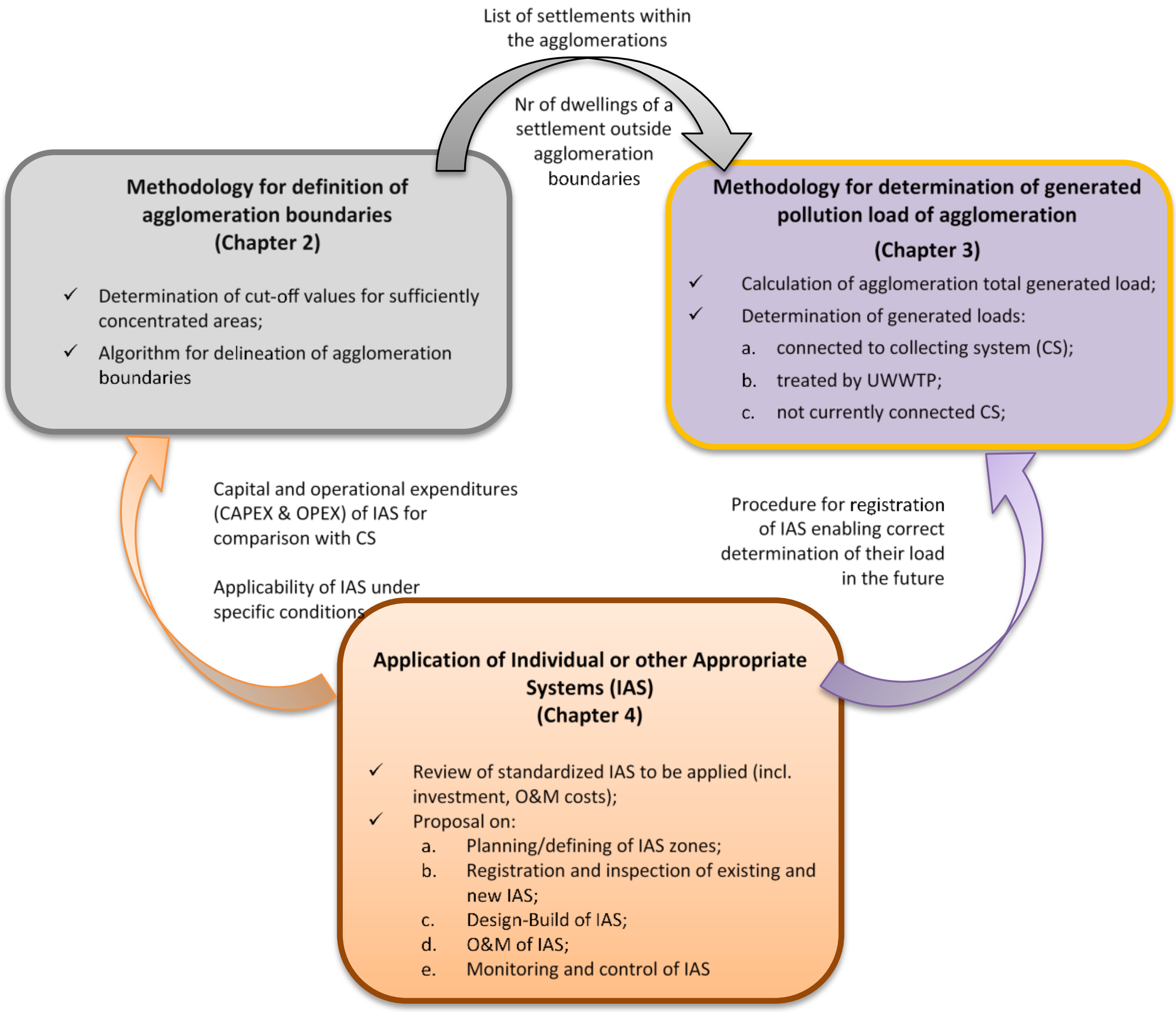
Chapter 4. provides information on the application of Individual or Other Appropriate Systems (IAS). It describes the requirements at EU and national level; what should be the process of IAS selection, planning for IAS zones, registration and inspection, designing and building of IAS, their operation and maintenance as well as monitoring and control. Recommendations for institutionalization of the proposed process in Romania are also provided.

Figure 2 below summarizes the relation and interactions among the methodologies for definition of agglomeration boundaries, determination of agglomeration load and approach for application of IAS, described in **Chapters 2**, **3** and **4** of the report. Systematic application of the proposed approach will:

- allow proper determination of the agglomerations' boundaries and load;
- help optimizing the cost for achieving UWWT Directive compliance; and,
- provide a solid base for compliance reporting.

The reader should consider the relations and interdependences of these chapters as well as the proposed holistic approach in tackling the UWWTD compliance requirements.

Figure 2: Summary of the approach



Source: WB elaboration for this report

Chapter 5. of the report covers some of the EU MS experience on UWWTD implementation and lessons to be learned. It presents information from Cyprus, Greece, Hungary, France and Portugal, which contains examples that are applicable for Romania.

Annex 1 includes the data used for calculation of CAPEX for collecting networks.
Annex 2 presents data used for calculation of CAPEX for small UWWTP.
Annex 3 refers to questionnaires submitted to WSS operators to collect data for the calculation of agglomeration pollution load.
Annex 4 provides examples on sufficient and insufficient WWTP inlet monitoring data.
Annex 5 gives details about the calculation of the pollution loads of Brasov and Codlea agglomerations.
Annex 6 contains description of IAS, which are considered suitable for Romania.
Annex 7 includes country reports on the international experience related to UWWTD implementation.

Chapter 2. Methodology for delineation of agglomeration boundaries

2.1 Requirements at EU and national level

4. Agglomerations play a central role in the concept of the UWWTD, which is why the proper delineation of their boundaries is of primary importance in the implementation process. The term “agglomeration” is specified in article 2-4 of the UWWTD as follows:

   “agglomeration” means an area where the population and/or economic activities are sufficiently concentrated for urban waste water to be collected and conducted to an urban wastewater treatment plant or to a final discharge point”

   The key concept of “sufficiently concentrated” is not further defined by the UWWTD. In order to ensure proper implementation as well as transparency in the reporting, more precise guidance/methodologies are needed. To help with the interpretation and implementation of the UWWTD, in 2007 the UWWTD-REP working group published its “Terms and Definitions of the UWWTD”[1]. It should be noted, however, that the guidelines are not an official document, and it is only the European Court of Justice that has the right to make definitive interpretations of the text of the Directive.

5. The document “Terms and Definitions of the UWWTD” confirms the following, which have been taken into consideration while preparing this methodological proposal:

   - Member States need to assess on a case-by-case basis, and in accordance with local conditions, the limits of each sufficiently concentrated area (i.e. agglomeration).
   - The delineation of agglomeration does not have to coincide with the delineation of the sewerage catchment, nor indeed with the administrative boundary. The delineation should reflect the borders of the “sufficiently concentrated” area.
   - The existence of an agglomeration is independent from the existence of collecting system (or a wastewater treatment plant).
   - Growth of the agglomeration or within the agglomeration must be taken into account when designing wastewater collecting systems (and WWTPs), hence demographics and urban planning becomes crucial.
   - Further, the document introduces the following concepts:
   - A coherent settlement which may be artificially divided by a river or highway should be considered as a single agglomeration.
   - A possibility of splitting a single “sufficiently concentrated” settlement into two different agglomerations, as long as it does not lower the requirement for collection and treatment.

   Another aspect, closely linked to the concept of agglomeration, is the establishment of a collecting system. Article 3-1 of the UWWTD specifies that:

   “Where the establishment of a collecting system is not justified either because it would produce no environmental benefit or because it would involve excessive cost, individual systems or other appropriate systems which achieve the same level of environmental protection shall be used.”

6. The first UWWTD Implementation Plan in Romania was adopted in October 2004 and became effective in 2007, targeting wastewater collection and load treatment in agglomerations above 10,000 people equivalent (p.e.) at the end of 2013 and 2015,

[1] http://ec.europa.eu/environment/water/water-urbanwaste/info/pdf/terms.pdf

respectively, and at the end of 2018 for agglomerations between 2,000 and 10,000 p.e. This plan identified the agglomerations in Romania and their total number for the first time.

In 2008, the Ministry of Environment and Sustainable Development of Romania published a document "Guidance on how to define agglomerations under the Urban wastewater treatment Directive 91/271". This document is consistent with the EU guidelines ("Terms and Definitions of the UWWTD"). It helped for establishing the initial definition of agglomeration boundaries in the country. However, it did not go further to suggest quantitative criteria for unified application by the local authorities involved in the process of definition of agglomeration boundaries. It introduced a criterion "critical distance" as follows:

"On the outskirts of an agglomeration, pay special attention to find the right border; set the borders of an agglomeration after a critical distance from currently built-up area and an area to be built up fulfilling the cost-effectiveness criterion. Beyond this critical distance, cost-effectiveness to connect the premises/settlements to a central sewer system is not assured and other technical solutions such as individual systems (i.e. septic tanks) should be considered".

With the preparation of the WSS Master Plans the county and local authorities were empowered to define and approve agglomeration boundaries. The lack of properly defined quantitative criteria at national level, have led to broadly defined agglomerations and resulted in significant investment costs to achieve compliance with the UWWTD and potential for payment of huge infringement penalties.

2.2 Current situation on agglomeration boundaries

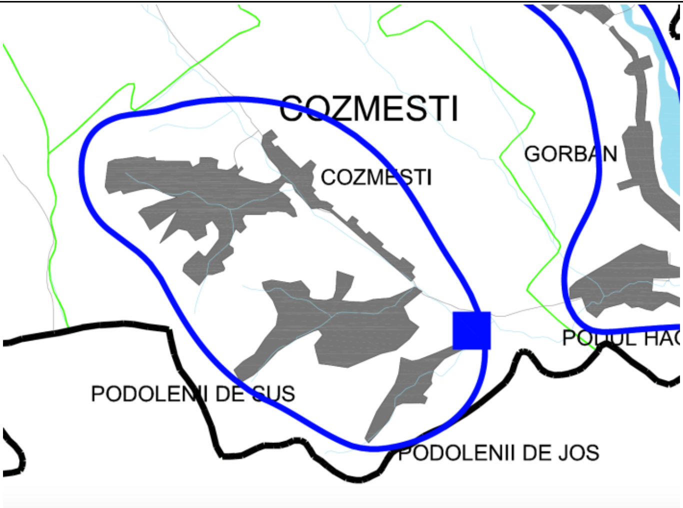
7. Currently, in most of the cases agglomeration boundaries coincide with the boundaries of the administrative units (towns or communes) as shown in Figure **3**

Figure 3 Current determination of agglomeration boundaries

Apart from the fact that this practice is not based on analysis with reference to "sufficiently concentrated areas" as per Art. 3 of the UWWTD, as mentioned above, this leads to excessive costs in meeting UWWTD requirements.

An example of broadly defined agglomeration boundary is shown in **Figure 4.**

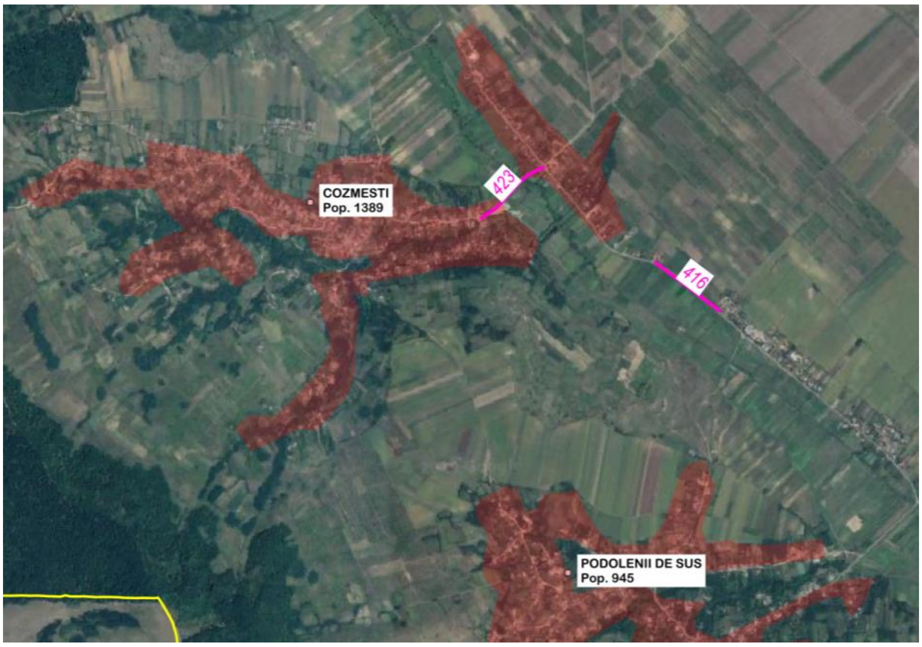
Figure 4: Agglomeration boundaries of Cozmesti commune, Iasi county



Source: the figure is taken from Iasi Feasibility Study 2014-2020

Agglomeration Cozmesti (2,845 p.e.) is included in the list of the agglomerations (ANAR, 2017). According to the administrative structure of Romania, Cozmesti is a commune, composed of three villages: Cozmești (1,389 citizens, NSI, 2011), Podolenii de Sus (945 citizens, NSI, 2011) and Podolenii de Jos (330 citizens, NSI, 2011). None of these three villages is above 2,000 p.e. As it can be seen from **Figure 5,** that these three villages are situated at a relatively big distance from each other, which indicates that this commune might not constitute a "sufficiently concentrated area". The village of Cosmesti itself is composed of some concentrated areas, situated at a certain distance as shown in Figure 5.

Figure 5: Two sufficiently concentrated areas in agglomeration Cozmesti with distance between them bigger than 400 m (CORINE Land Cover)



Source: WB elaboration for this report

Furthermore, the land plots in Cozmesti are relatively big (houses are not close to each other), thus cost per person connected will be significant, see **Figure 6.**

Figure 6: Visualization of the low-density population of Cozmesti

Source: WB elaboration for this report

In conclusion, this example shows that:

A. The current agglomeration boundary of Cozmesti is not consistent with the concept of "sufficiently concentrated area" of the UWWTD, since it includes at least 3 concentrated areas (the three villages), situated at a long distance from each other.

B. Each village is below 2,000 p.e.

C. There will be excessive costs for construction of collecting system in this agglomeration due to: small number of people per km pipe as well as need of long connecting pipes between the three villages.

Since there are many more examples of broadly defined agglomeration boundaries that the WB team has found, it is urgent that a national Methodology for delineation of agglomeration boundaries is developed to help Romanian authorities to: 1) have a consistent approach; 2) optimize compliance costs; 3) improve reporting on UWWTD and overall to 4) understand better the situation with regard to collection and treatment of wastewater in the country.

2.3 Proposed approach

8. Historically, urban developments have been formed in most cases from densely populated central areas and peripheries with a lower density. While central areas in most of the cases are more suitable for centralized collection systems, for the peripheries it is not always easy to decide whether they are "sufficiently concentrated". Two options for definition of agglomeration boundaries could be considered, respectively excluding or including areas with lower density as shown in the **Figure 7** below.

Figure 7: Visualization of two options for delineation of agglomeration boundaries

Option 1: Agglomeration boundary (in yellow) is equal to settlement boundary

Option 2: Agglomeration boundary (in yellow) excludes low densely populated areas (red area A)

Source: WB elaboration for this report

The advantages and disadvantages of these options are shown in the table below:

Table 2: Advantages and disadvantages of options for delineation of agglomeration boundaries

	Option 1 (includes lower density areas)	**Option 2** (excludes lower density areas)
Advantages	The option may fulfil the expectations of citizens about not being "left out".	Applies more strictly the definition of the UWWTD for "sufficiently concentrated".
		Results in a reduction of the size of agglomeration and associated cost of infrastructure, hence avoids excessive costs for infrastructure.
Disadvantages	Including lower density areas may result in higher investment and operating cost if demands for centralized systems are misunderstood, *e.g.* if there is an expectation for piped collection covering the whole agglomeration area.	The level of environmental protection may be reduced in the sparsely populated areas outside the new agglomeration boundaries due to application of traditional IAS solutions rather than appropriate IAS solutions that provide better level of environmental protection.
		If the settlement grows in this direction, in a certain time it will become "sufficiently concentrated" and agglomeration boundaries should be reconsidered.

Comparing the advantages and disadvantages of the two options, Option 2 appears as more favorable since it provides more advantages as well as its disadvantages could be mitigated by adoption of appropriate policies. Thus, Option 2 will be considered in the proposed methodology.

2.4 Defining cut-off values

APPROACH

9. Many of the Romanian settlements are situated along one or two long streets/roads, i.e. the urbanization is predominantly linear. Considering this specificity, a distance cut-off criterion based on the parameter "people connected per 100 meters of pipe" is proposed to distinguish areas with "sufficiently concentrated" population and economic activities from areas with less concentrated activities, i.e. to make a decision which areas should be included in the agglomeration boundaries. This reflects the following:

    1) The more people are connected per 100 m pipe, the more concentrated population and economic activities will be in the corresponding area; and

    2) The more people are connected per 100 m pipe, the cheaper the price per person to collect wastewater will be.

10. Therefore, there is a significant correlation between the term "sufficiently concentrated" used in the UWWTD to define an agglomeration and the cost of the collecting system. The methodology proposes that the cut-off value for "sufficiently concentrated" are is linked to comparison of the cost for construction and operation of collecting system and individual solutions (IAS).

DATA USED

11. **CAPEX for the collecting systems:** information on historical project costs and estimated project costs from Feasibility Studies (FS) financed under Large Infrastructure Operational Programme (LIOP) has been analyzed. Completion reports from EU funded WSS projects received from Ministry of EU Funds covering 2007-2014 budgetary framework were also reviewed. The data used are shown in **Annex 1: Data used for calculation of CAPEX for collecting networks (FS for LIOP financing)**. In total 96 projects are included in this analysis. The data covers the following information:

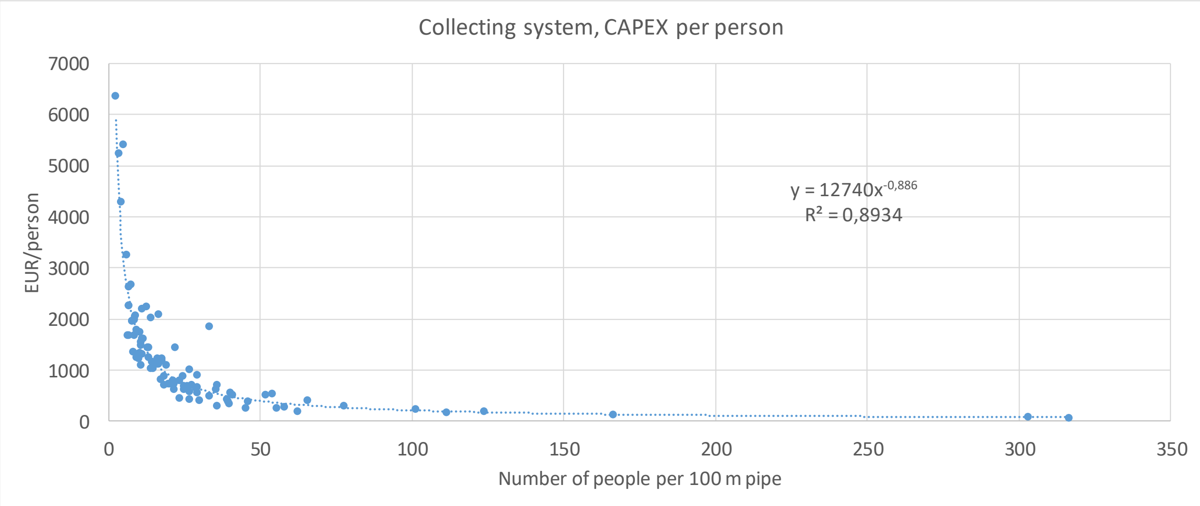
    - People to be connected to the system;
    - Length of the new pipelines (main and secondary);
    - Costs for construction (pipes, collectors, pumping stations), EUR.

    Based on these data, the following has been calculated:

    - Cost per person connected, EUR.
    - Number of people connected/100 m constructed sewer pipe.

12. The data can be correlated to show a relationship between the people connected per 100 m and the cost per person. The correlation is shown in **Figure 8** below.

Figure 8 CAPEX determination for the collecting systems (EUR/person) in relation to people connected per 100 m pipe



Source: WB elaboration for this report

The data shows that there is a strong correlation (R^2 =0.89) between number of people per 100 m pipe and cost of collecting system per person.

13. **CAPEX for IAS:** there are a significant number of IAS that are available on the market, each of them having their own specificities related to technology, environmental protection and of course price. The cheapest and most commonly used IAS in Europe for providing a good ratio between environmental benefits and CAPEX and OPEX costs is presented here for comparative purposes: IAS1 Septic tank plus soil infiltration system. More details about this and other IAS are provided in **Annex 1: Data used for calculation of CAPEX for collecting networks (FS for LIOP financing)6**.

ASSUMPTIONS AND CALCULATIONS

14. **General assumption:** Areas with residential buildings for more than 2 households (i.e. residential blocks) will be included in the agglomeration boundaries since there is high concentration of human activities. The cut-off criterion will be relevant only for individual houses. The cost for house connection to the collecting system is estimated at 500 EUR (length of 5 m pipe outside the private property and cost of 100 EUR/m to lay the pipe).

15. **Net Present Value:** NPV is calculated based on 50-year time horizon at 4 percent discount rate (explanations are provided below), accounting for both CAPEX and OPEX. The other assumptions are as follows:

- The economic lifetime of all civil construction facilities (IAS, collecting system) is 50 years;
- The economic lifetime of the equipment is 10 years;
- The equipment renewal will be once per 10 years;
- The discount rate is 4 percent in real terms as an indicative benchmark for discounting cash flows back to the present[2].

[2] Art. 19 (3) of Commission Delegated Regulation (EU) No 480/2014

16. **OPEX calculations and assumptions:** the assumption in regard to determination of the annual OPEX of the sewerage network are based on the international experience. One of the good international text books[3] state costs for Operations and Maintenance of collecting system as 1 to 1.5 percent of investment costs. Another study[4] cites values of 0.3 to 0.5 percent for O&M of sewer systems.

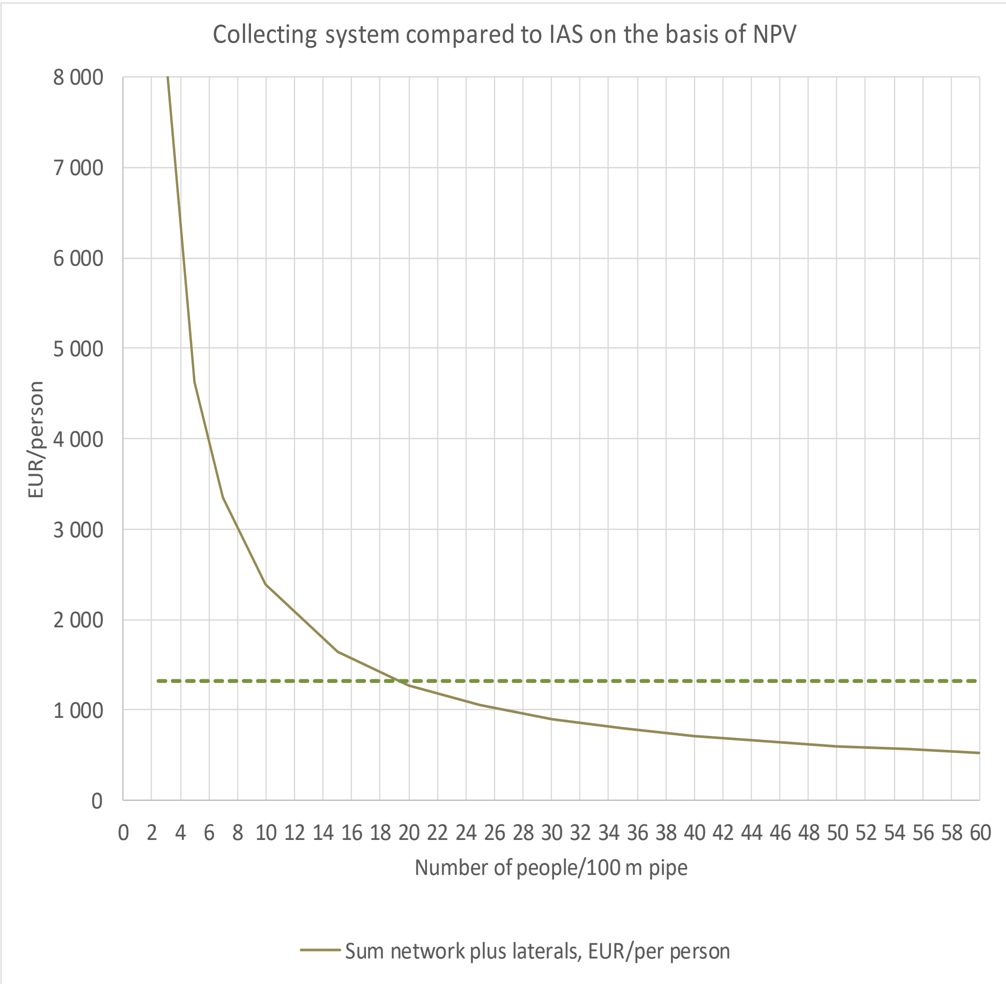
In this report, the following value are used:

- O&M costs for the collecting system: 1 percent of its CAPEX.
- OPEX of IAS is based on actual market costs.

DETERMINATION AND ANALYSIS OF THE CUT-OFF CRITERIA

17. For determination of the cut-off value, NPV of a collecting system and IAS were compared. NPV of the collecting system was calculated based on: 1) the equation, providing relationship between CAPEX and people, connected per 100 m pipe; 2) the CAPEX for connecting a house to the collecting system; and 3) OPEX as described above. NPV of the IAS was calculated based on the current market costs.

Figure 9: Collecting system compared to IAS1 on the basis of NPV



Source: WB elaboration for this report

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[3] Teknisk Hygiejne. Spildevands teknik. Leif Winter et al. Polyteknisk Forlag.1990

[4] Decentralized wastewater treatment technologies from a national perspective: at what cost are they competitive? Water Science and Technology: Water Supply. Vol 5, No. 6. IWA Publishing 2006.

Figure 9 shows that the piped sewerage system is cheaper than IAS1 when there are more than 19 people connected per 100m, i.e. 7 houses[5].

Suggested cut-off criteria: 19 people connected per 100m or 7 houses/100 m pipe

18. In the periphery of a settlement where the distances between houses are becoming larger a value of 250 meters, adopted from the international practices[6] is applied, i.e. if the distance between the main zone and a remote zone is bigger than 250 m., the remote zone will not be included in the agglomeration boundary[7].

a. Delineation of agglomeration boundaries

GIS INPUT DATA AND PROCEDURES

19. The GIS related information (data, maps) necessary for the delineation process:

- Aerial or satellite Orthophoto images or their analogue (Google satellite imagery);
- GIS layers with the Local administrative units (LAU2) – borders downloaded from the ANCPI through INSPIRE Geoportal;
- GIS layers with the boundaries of the built-up areas „intravilan" (existing or building permission) of all Romania's settlements (ANCPI, as obtained by the World Bank);
- GIS layer of the population grid (National Institute of Statistics);
- GIS layers with Existing collecting system (obtained from water operators, with support from ANRSC);
- Corine Land Cover (CLC) 2018;
- Resident population number 2018 for each settlement (derived by the team from the National Institute of Statistics dataset at LAU2 level.)

GIS preparatory procedures:

- Data structuring – all available data is reorganized in a new database. For easier data operation, the information is separated by counties and loaded in open source GIS software (QGIS 3.6);
- Overlaying and alignment of all available GIS data – the data are usually in different file types and coordinate systems. The information is set in the official coordinate system of Romania – EPSG: 3844 (Pulkovo1942(58)/Stereo70) using different tools georeferencing or transformation in GIS software's.
- GIS layer creation and style definition – for the purposes of the project, 3 new layers are defined in suitable layer types and styles.
- Manual delineation of the agglomeration boundaries, considering the established methodology in predefined polygon layer for each county.

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[5] Using 2.67 people/house, NSI, census 2011

[6] Advisory Program for Strengthening the Capacity of the SEWRC and Optimizing Cost of Compliance with Directive 91/271/EEC, Bulgaria, 2015

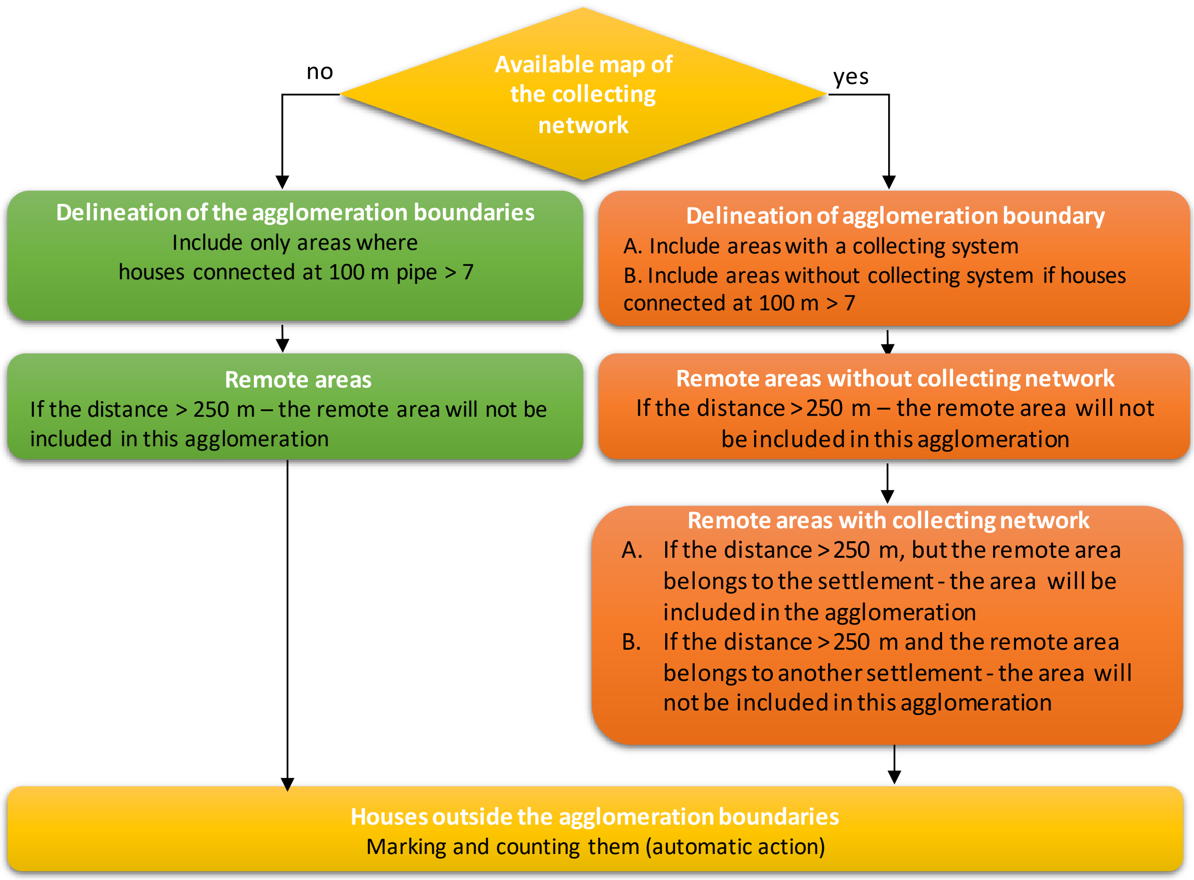
[7] Higher distances between houses can result in excessive cost for building collecting systems. However, the value of 250 m. is just general reference and could be modified or waived if during the FS preparation there is evidence and rational that a better environmental option is to connect a polluter, which is situated at 255 meters for example.

- Population data check – manually marking the houses outside of the agglomeration boundaries in predefined point layer. After the house marking, automatically house counting is executed by GIS tools for each agglomeration and the received data is presented in Excel sheet.

ALGORITHM FOR DELINEATION OF AGGLOMERATION BOUNDARIES

20. The next few figures are provided for explaining and providing visualization of the main steps of the algorithm.

Figure 10: Algorithm for delineation of agglomeration boundaries



Source: WB elaboration for this report

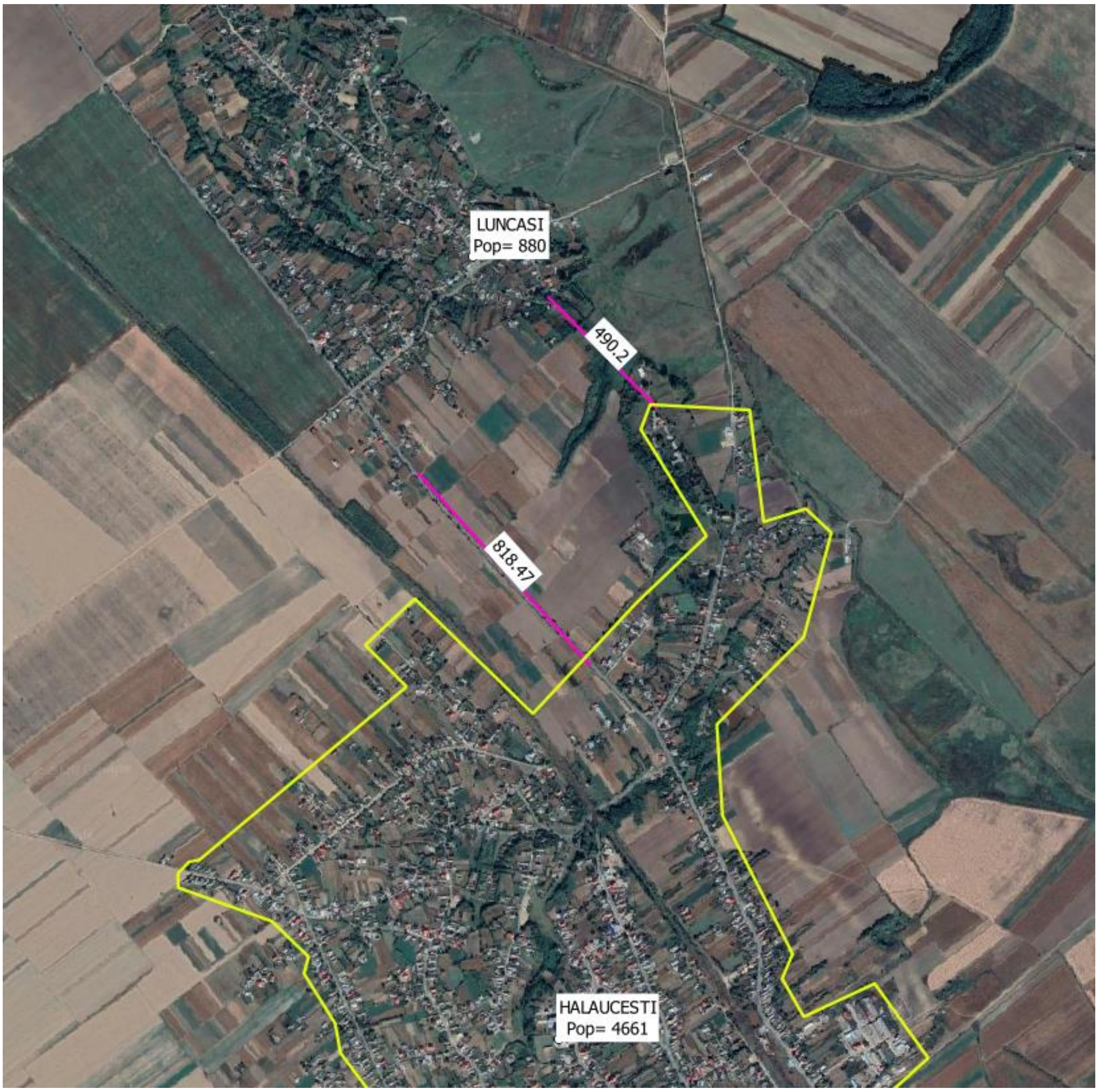
Delineation of the agglomeration boundaries
Include only areas where
houses connected at 100 m pipe > 7

Figure 11 Visualization of included areas with high density and excluded areas with low density (where number of houses per 100 m pipe > 7)

Source: WB elaboration for this report

Remote areas
If the distance > 250 m – the remote area will not be included in this agglomeration

Figure 12: Visualization for exclusion of remote areas, situated at distance > 250 m



Source: WB elaboration for this report

Delineation of agglomeration boundary
A. Include areas with a collecting system
B. Include areas without collecting system if houses connected at 100 m > 7

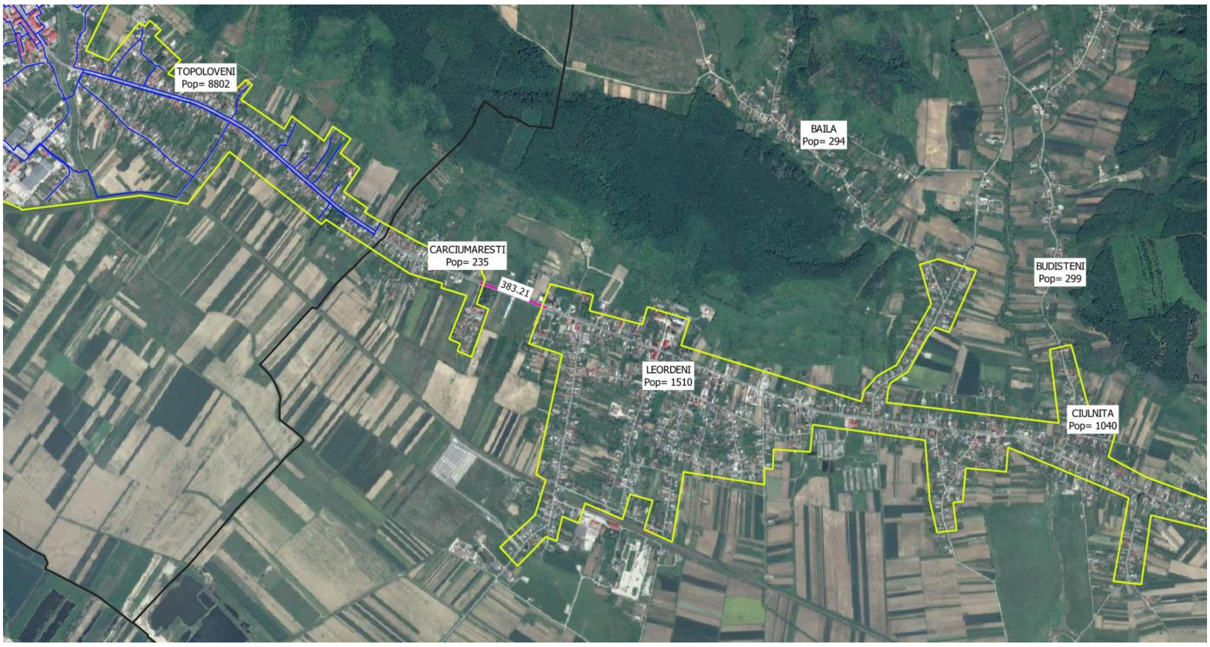
Figure 13: Visualization for delineation of the boundaries with available map of collecting system

Source: WB elaboration for this report

The figure shows that included areas cover: 1) existing collecting system and 2) high density. Excluded areas are those not qualifying to "sufficiently concentrated" criterion (less than 7 houses per 100 m pipe) and without collection system.

Remote areas without collecting network
If the distance > 250 m – the remote area will not be included in this agglomeration

Figure 14: Visualization for remote area without collecting system at distance > 250 m



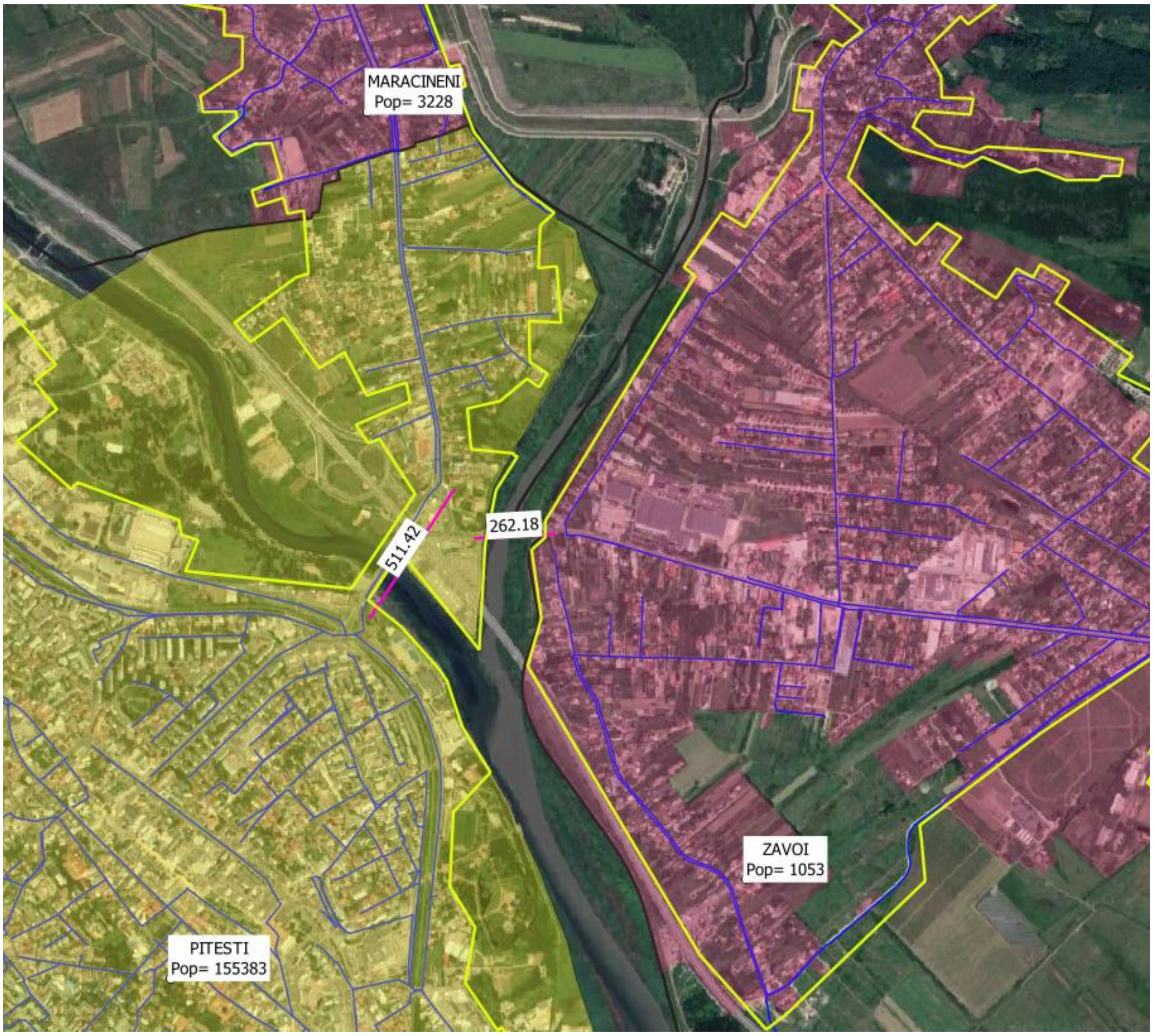
Source: WB elaboration for this report

According to the criteria, the remote area (settlement Leordeni) is not included in the agglomeration of Topoloveni but is included in another agglomeration because it is "sufficiently concentrated" area.

Remote areas with collecting network

A. If the distance > 250 m, but the remote area belongs to the settlement - the area will be included in the agglomeration
B. If the distance > 250 m and the remote area belongs to another settlement - the area will not be included in this agglomeration

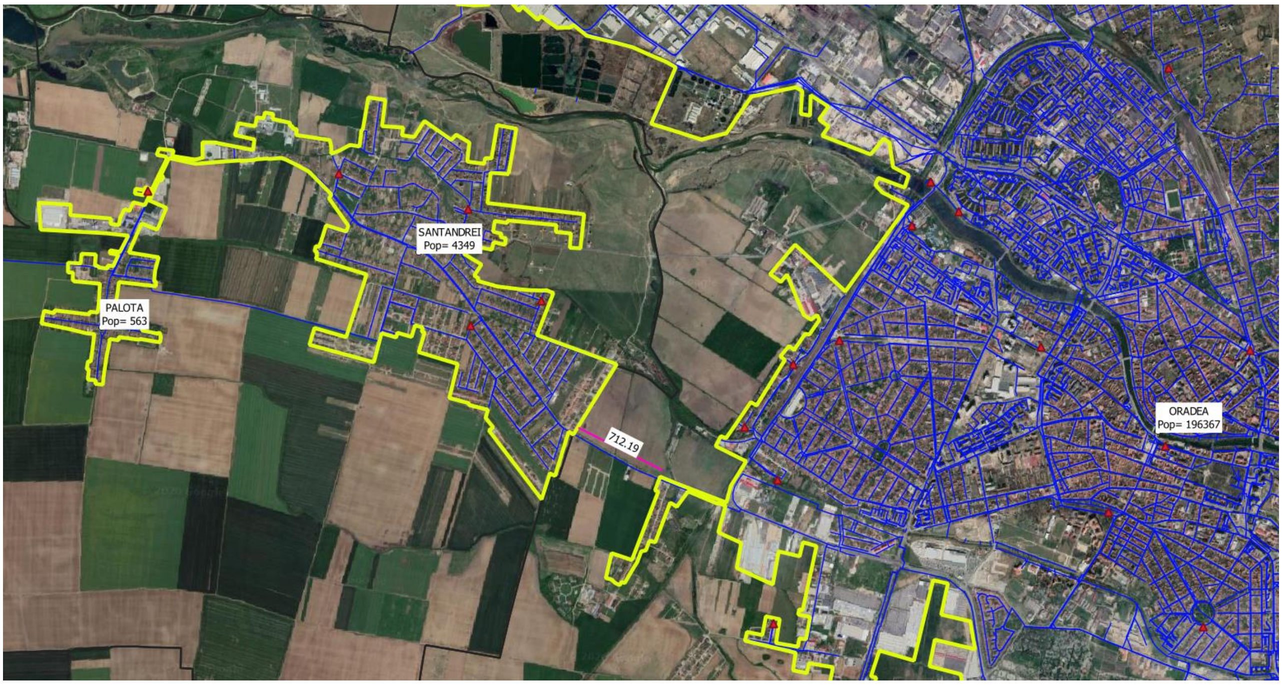
Figure 15: Visualization of situation A



Source: WB elaboration for this report

In situation A (see the yellow background), the town of Pitesti has a remote area at a distance of 511.42 m. > 250 m., however this area has a collecting system linked to the main network and as a result the area is included in the agglomeration boundaries of Pitesti.

Figure 16: Visualization for situation B



Source: WB elaboration for this report

In situation B there are two settlements – Santandrei and Oradea, that belong to the same collecting network. However, the distance between them is 712.19 m > 250 m, so they are delineated as two deferent agglomerations.

APPLICATION OF THE METHODOLOGY IN BRASOV COUNTY

21. An example for application of the methodology for delineation of agglomeration boundaries is presented for Brashov county. The results show the following:
    - Revision of agglomeration boundaries for existing agglomerations (for example Brasov);
    - Formation of new agglomerations (for example Cristian);
    - Exclusion of existing agglomerations (for example Cata);
    - Merging of existing agglomerations (for example Moeciu is merged with Bran).

    To sum up, Brasov county currently has 41 agglomerations (ANAR database as at December 31, 2017). With the implementation of the methodology there will be 3 new agglomerations and 20 will no longer be reported for the purposes of UWWTD implementation (of which 4 are merged with another agglomeration, 15 are below 2,000 p.e., 1 has lower density than the cut-off value). This means that in Brasov county will be in total 25 agglomerations, delineated by applying the methodology. This represents 36% reduction of the number of the agglomeration. The table below presents the discussed information:

Table 3: Delineated agglomerations in Brasov county

Proposed methodology		ANAR list	
Agglomeration name	**Settlements in the agglomeration**	**Agglomeration name ANAR**	**Settlements in the agglomeration**
Apata	Apata	Apata	
Bod	Bod	Bod	Bod
	Colonia Bod		Colonia Bod
Bran	Bran	Bran	Bran
	Cheia		Predeal
	Moieciu de Jos		Pestera
	Tohanu Nou		Sohodol
	Simon		Simon
Brasov	Brasov	Brasov	Brasov
	Ghimbav		Poiana Brasov
	Sanpetru		Tohanu Nou
	Sacele		Sacele
Budila	Budila	Budila	
Codlea	Codlea	Codlea	
Cristian	Cristian		
Crizbav	Crizbav		
	Cutus		
Dumbravita	Dumbravita	Dumbravita	Dumbravita
			Vladen
Fagaras	Fagaras	Fagaras	
	Hurez		
Feldioara	Feldioara	Feldioara	Feldioara
			Colonia reconstructia
			Rotbav
Halchiu	Halchiu	Halchiu	Halchiu
			Satu Nou
			Crizbav
			Cutus

Proposed methodology		ANAR list	
Agglomeration name	Settlements in the agglomeration	Agglomeration name ANAR	Settlements in the agglomeration
Harman	Harman	Harman	Harman
			Podu Olt
Hoghiz	Hoghiz	Hoghiz	
Poiana Brasov	Poiana Brasov		
Predeal	Predeal	Predeal	Predeal
	Paraul Rece		Paraul Rece
			Timisu de Sus
			Timisu de Jos
Prejmer	Lunca Calnicului	Prejmer	Lunca Calnicului
	Prejmer		Prejmer
			Stupinii Prejmerului
Racos	Racos	Racos	Racos
			Mateias
Rasnov	Rasnov	Rasnov	
Rupea	Rupea	Rupea	Rupea
			Fiser
Tarlungeni	Carpinis	Tarlungeni	Carpinis
	Purcareni		Purcareni
	Tarlungeni		Tarlungeni
	Zizin		Zizin
Teliu	Teliu	Teliu	
Victoria	Victoria	Victoria	
Vulcan	Vulcan	Vulcan	Vulcan
			Colonia 1 Mai
			Holbav
Zarnesti	Zarnesti	Zarnesti	

Table 4: Excluded agglomerations for UWWTD reporting purposes:

ANAR N	ANAR name	Reason for exclusion
327	Cata	below 2,000 p.e.
328	Comana	below 2,000 p.e.
331	Ghimbav	merged with BRASOV
335	Homorod	below 2,000 p.e.
336	Jibert	below 2,000 p.e.
337	Maierus	below 2,000 p.e.
338	Moeciu	merged with BRAN
339	Ormenis	below 2,000 p.e.
340	Parau	below 2,000 p.e.
341	Poiana Marului	low density
344	Sanpetru	merged with BRASOV
345	Sercaia	below 2,000 p.e.
346	Sinca	below 2,000 p.e.
347	Soars	below 2,000 p.e.
350	Ucea	below 2,000 p.e.
351	Ungra	below 2,000 p.e.
352	Vama Buzaului	below 2,000 p.e.
354	Vistea	below 2,000 p.e.
355	Voila	below 2,000 p.e.
BV325	Bran	Predelut

Chapter 3. Methodology for determination of pollution load

3.1 Objectives

22. The Methodology for determination of the agglomeration load aims at providing a clear, step-by-step approach for determining the generated load, respectively the agglomeration size, pursuant to the requirements of the UWWTD[8] and the principles established in the Guidance "Terms and Definitions of the Urban Waste Water Treatment Directive 91/271/EEC" (UWWTD-REP)[9].

The Methodology should:

- Provide a reliable background for assessing options for optimization of compliance costs for the agglomerations above 2,000 p.e.;
    - Guide the recalculation of the generated agglomeration load based on the newly delineated boundaries and the specific up-to-date data base collected for each agglomeration;
    - Improve the determination of the generated load and the number of population that is currently not connected to collecting system (CS), but it is appropriate to be connected to CS based on economic criteria provided in **Chapter 2.** of the report;
    - Support the determination of the generated load, which is currently not connected to a UWWTP, but must be connected in the future.
- Facilitate the compliance reporting in accordance to Art. 15 of the UWWTD.

The Methodology will also assist the Romanian Government to report on UWWTD implementation by providing:

- a sound step-by-step algorithm on the way of determining the generated agglomeration load (i.e. the agglomeration size in p.e.);
- an evidence that the determination of the generated load is based on reliable and up-to-date data base collected for each agglomeration;
- a list with the newly delineated agglomerations and the name of settlements (localities) included in each agglomeration;
- information on "percentage of change of size of the agglomeration" in comparison to the agglomeration size in the last reporting. If the difference is more than 20 percent, it will be highlighted;
- information on "percentage of change of the entering load" in the UWWTP in comparison to the reported value in the last compliance reporting. If the difference is more than 20 percent, an explanation will be provided on load calculation. Similar information will also be presented in case load goes below

[8] https://ec.europa.eu/environment/water/water-urbanwaste/index_en.html
[9] http://ec.europa.eu/environment/water/water-urbanwaste/info/pdf/terms.pdf

10,000 p.e. or 2,000 p.e. or the agglomeration becomes compliant with Art. 3 of the UWWTD.

3.2 Requirements regarding agglomeration load

23. The UWWTD establishes a regulatory framework for environmental protection against pollution from urban wastewater discharge. The requirements for wastewater treatment depend on the size of the agglomeration, defined in terms of organic load and expressed as "population equivalent" (p.e., where 1 p.e. = 60 gBOD5/d). Thus, the wastewater management at the level of the agglomeration is linked to the generation of (organic) pollution load within its boundaries.

The size of the agglomeration presents the summary organic load (in p.e.) of all contributing emitters within agglomeration. In accordance with the guidance in UWWTD-REP the emitters can be grouped as follows:

- Resident population;
- Non-resident population;
- Industries – covered by Article 11 of the UWWTD and other industries that do, or shall, discharge into the collecting system;
- All remaining wastewater generated in an agglomeration.

Thus, the agglomeration load can be expressed as[10]:

$$aggGenerated = L_{agg\ PR} + L_{agg,NonPR} + L_{agg,IND} + L_{agg,X} \qquad (1)$$

aggGenerated	generated load within the agglomeration in p.e.;
$L_{agg\ PR}$	the generated load of resident population, in p.e.;
$L_{agg\ Non\ PR}$	the generated load of non-permanent residents (e.g. tourists, seasonal workers), in p.e.;
$L_{agg,\ IND}$	the generated load of industrial emitters connected to CS, in p.e.;
$L_{agg,X}$	the generated load of other emitters (if any), in p.e. It may include small units of the service/public sector for instance that are currently serviced by IAS and which in specific cases may significantly affect the load of agglomeration. In some western countries this parameter refers to the load from cleaning household cattle premises, for which there is information that the wastewater that enters the sewer system.

In case of existing UWWTP, the summary load of the resident population, non-permanent residents and industrial emitters that enter the UWWTP can be calculated according to Art. 4(4) of the UWWTD, i.e. *"The load expressed in p.e. shall be calculated on the basis of the*

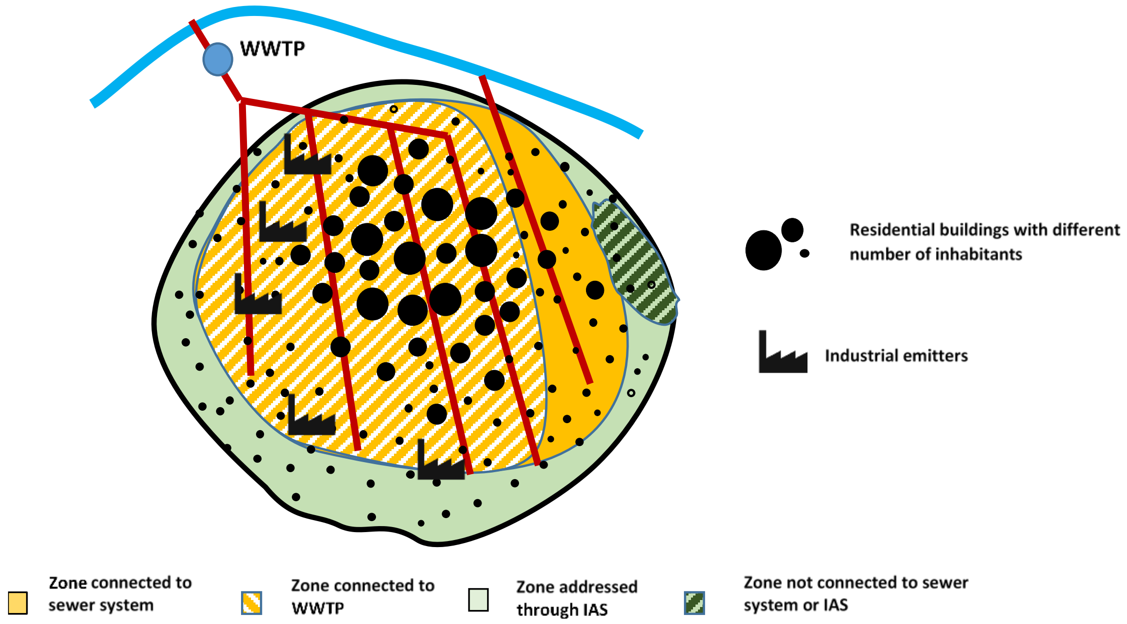
[10] The definitions and the short names of the parameters are identical with the definition and short name of the same parameter (if such) in the dataset for reporting compliance with Art. 15 of the UWWTD. http://dd.eionet.europa.eu/datasets/latest/UWWTDArt15/tables/Agglomerations/

maximum average weekly load entering the treatment plant during the year, excluding unusual situations such as those due to heavy rain".

3.3 Approach

24. Requirements for reporting compliance according to Art. 15 of the UWWTD[11] necessitate differentiation to be made of the agglomeration load, based on the types of wastewater management within the agglomeration. Depending on the social and economic development, as well as on the cultural habits of the population, the following types of wastewater management can exist within an agglomeration, see **Figure 17**.

Figure 17: Conceptual models of wastewater management (WWM) within an agglomeration



Source: WB elaboration for this report

The centralized collecting system, including wastewater treatment is considered to be the most environmentally friendly and economically feasible solution for urbanized, densely populated areas. The UWWTD allows however the application of decentralized solutions (IAS) in specific cases,

"where the establishment of a collecting system is not justified either because it would produce no environmental benefit or because it would involve excessive cost, individual systems or other appropriate systems which achieve the same level of environmental protection shall be used" (Art.3 of UWWTD).

Following the requirements for reporting compliance with Art.15 of the UWWTD, the generated agglomeration load should be expressed as:

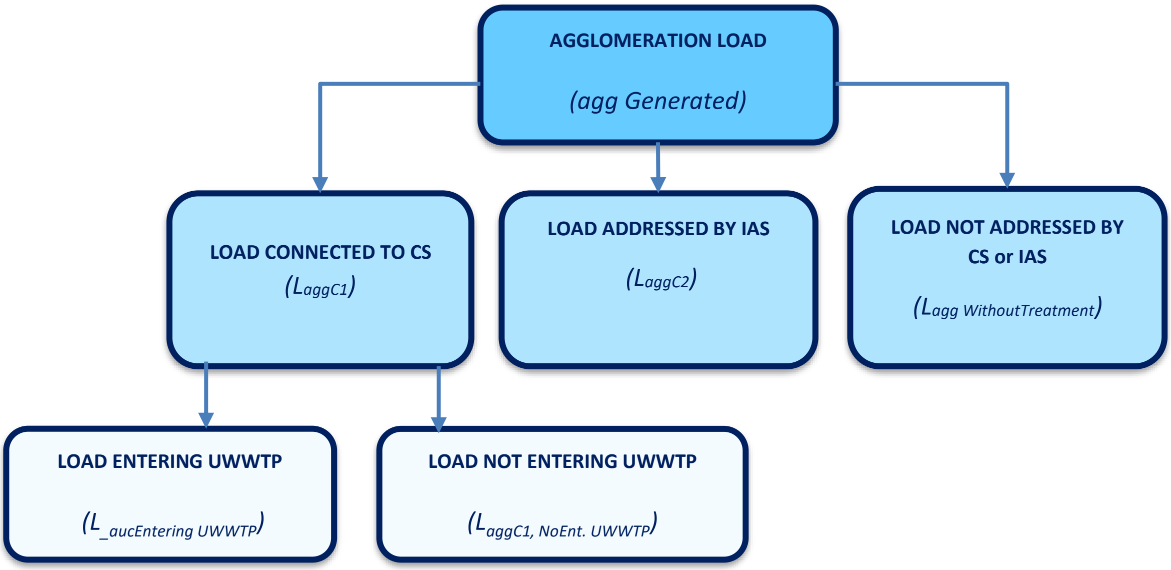
$$aggGenerated = L_{aggC1} + L_{aggC2} + L_{\mathrm{aggWithoutTreatment}} \quad (2)$$

[11] http://dd.eionet.europa.eu/datasets/latest/UWWTDArt15/tables/Agglomerations

agg Generated	the generated load within the agglomeration in p.e.;
L_{aggC1}	the generated load of agglomeration collected through CS, in p.e. L_{aggC1} can be further précised into: i) load entering the UWWTP and ii) load connected to CS but discharged without treatment.
L_{aggC2}	the generated load of agglomeration addressed through IAS, in p.e.;
$L_{agg\ WithoutTreatment}$	the generated load of agglomeration not collected through CS and not addressed through IAS, in p.e.

The methodology will calculate the total generated load of the agglomeration together with the following key components, see **Figure 18**.

Figure 18: General concept for calculation the agglomeration load



Source: WB elaboration for this report

3.4 Assumptions

25. The Methodology determines the generated load of agglomeration based on the following general assumptions:

- The load generated by one resident equals to 60 $gBOD_5$/cap/d, i.e. equals 1 p.e. This assumption is applied in case the generated load of the resident population is not connected to an existing UWWTP or there is no sufficient monitoring data concerning the loads entering the existing UWWTP.
- The load generated by one tourist equals to 60 $gBOD_5$/cap/d, i.e. equals 1 p.e. This assumption is applied in case there is evidence that the generated load of the tourist accommodation facilities is not connected to an existing UWWTP or there is no sufficient inlet monitoring data concerning the loads entering the existing UWWTP.
- Residents connected to existing collecting systems are those legally using the wastewater collecting service, i.e. serviced by an operator or municipal department.

Residents, who are not physically connected to the existing sewer system or use it illegally are not considered as connected to collecting system.

3.5 Determination of resident population in the agglomeration

26. The resident population is the key component in determining the agglomeration size. Two databases are available at national level with regard to the population:

- Database on resident population in a settlement based on address registration;
- Database on usual resident population in a settlement[12].

The practice shows that often people do not change their address registration when changing their place of living. In other words, there are people continuously living at places different from their address registration (i.e. in different settlements or even abroad). Therefore, it is not recommendable that the address registration data is used for calculation the agglomeration loads.

NSI has statistical data about the usual resident population in each settlement at 2011, based on 2011 national census. For more recent years there is statistical information about the usual resident population at county level, as well as residents in urban areas and residents in rural areas. This data is used for determining the population in the agglomerations.[13]

The number of usual resident population in each settlement according to Census 2011 will be used as a basis for determining the usual resident population in 2018, assuming that:

1) The data about usual resident population in a settlement, reflecting where people live physically, is representative for the purpose of determining the agglomeration load;
2) The percentage contribution of resident population of a settlement of the urban area compared to the total urban resident population of the county is the same in 2011 and 2018;
3) The percentage contribution of resident population of a settlement of the rural area compared to the total rural resident population of the county is similar (less than 5 percent error) in 2011 and 2018;

Thus, the total number of usual resident population in 2018 for a given settlements is calculated as:

[12] According to the definition of the Romanian NSI *"Resident population represents all persons of Romanian nationality, foreign or stateless who have their usual residence in Romania. Usual residence is the place where a person normally spends the daily period of rest, regardless of temporary absences for purposes of recreation, holidays, visits to friends and relatives, business, medical treatment or religious pilgrimage. Usual residence may be the same as the domicile or may differ from it, for the persons who choose to establish their usual residence in a locality other than the locality of domicile in the country or abroad. It is considered having their usual residence in a specific geographic area just people who have lived in that usual residence for a continuous period of at least 12 months prior to reference moment. The usual resident population includes the persons who immigrated to Romania but excludes the persons who emigrated from Romania. "*

[13] **Data Source**: NSI, Romania (http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, File: POP105A - Usually resident population by age group and ages, sex, urban/ rural area, macro-regions, development regions and counties at January 1st.)

$$PR_{S,2018} = \frac{PR_{U/R,2018}}{PR\ U/R,2011}\ x\ PR_{S,2011} \qquad (3)$$

$PR_{S,\ 2018}$ total number of usual resident population of the settlement in year 2018;

$PR_{S,\ 2011}$ total number of usual resident population of the settlement in year 2011 *(source: NSI)*;

$PR_{U/R,\ 2018}$ total number of usual resident population in urban, respectively rural area of the county in 2018, depending on the settlement affiliation to urban area or rural area, as stated in the data base of Census 2011 *(source: NSI)*;

$PR_{U/R,\ 2011}$ total number of usual resident population in urban, respectively rural area of the county in 2011, depending on the settlement affiliation to urban area or rural area, as stated in the data base of Census 2011 (*source: NSI)*

The total number of usual resident population in 2018 for a given agglomeration is calculated as the sum of the permanent population of the settlements forming the agglomeration minus the population excluded from the agglomeration based on the criteria for agglomerations boundary delineation, as shown on the agglomeration's map, i.e.

$$PR_{AGG,2018} = (PR_{S1,2018} - PR_{EX,S1,2018}) + (PR_{S2,2018} - PR_{EX,S2,2018}) \dots + (PR_{Sn,2018} - PR_{EX,SN,2018}) + PR_{IN,Sn+1,2018} \quad) \ (4)$$

$PR_{AGG,\ 2018}$ total number of usual resident population of the agglomeration in year 2018;

$PR_{S1,\ 2018}$, $PR_{S2,\ 2018}$, $PR_{Sn,\ 2018}$, total number of usual resident population of the settlements (1,2,..n), in year 2018.

$PR_{EX,S1,\ 2018}$, $PR_{EX,S2,2018}$, $PR_{EX,Sn,2018}$ total number of usual resident population of the settlements (1,2,..n), in year 2018, which is outside from agglomeration boundaries. This number is determined based on the houses outside of the agglomeration boundaries and the average number of people per dwelling in 2018. The average number of people per dwelling is different in the urban and rural areas of the county. It is calculated based on the total number of usual residents and total number of dwellings in urban/rural areas of the county using NSI data;

$PR_{IN,Sn+1,\ 2018}$ total number of usual resident population of the settlement (n+1), in year 2018, which is included to the given agglomeration. There are cases where some scattered residential areas of a distant settlement can be included to another agglomeration, based on criteria for agglomeration boundaries delineation. This number of resident population is determined in a similar way as the number of excluded population.

3.6 Generated load of agglomeration connected to collecting system (LaggC1)

27. Calculation of each component of the generated load specified in Equation 2 and on Figure 19 is explained below.

The load connected to the CS is calculated as:

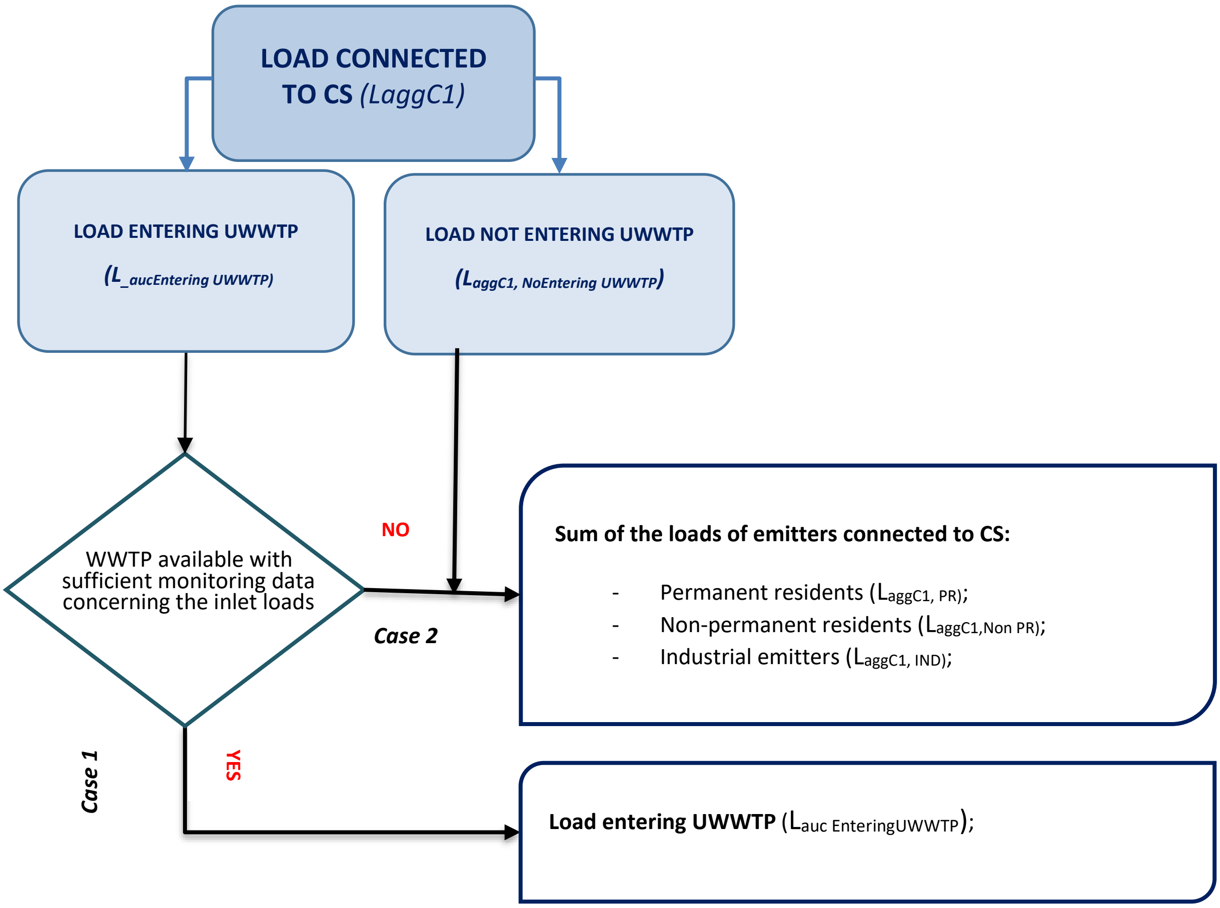
$$L_{aggC1} = L_{\text{aucEnteringUWWTP}} + L_{aggC1,NoEnt.UWWTP} \qquad (5)$$

L_{aggC1} the generated load entering the CS, in p.e.;

$L_{auc\ EnteringUWWTP}$ the load entering the UWWTP, in p.e.;

$L_{aggC1,\ NoEnt.UWWTP}$ the load collected through CS, but not treated in the UWWTP in p.e.;

Figure 19: Calculation algorithm for determining the load entering the collecting system (LaggC1)



Source: WB elaboration for this report

The review of current Report for compliance[14] acc. to Art. 15 of UWWTD shows that there are just a few agglomerations (e.g. Bucharest), where not all sewer collectors are connected to a UWWTD (i.e. $L_{aggC1,\ NoEnteringWWTP}$ is different from zero). Such cases will be dealt with separately. The fraction of the generated load that is collected but not entering the UWWTP shall be calculated in a similar way as described in Case 2 below.

[14] Status December 2017

The most common case is that all the generated load collected through collecting system is treated into the UWWTD, then equation 5 becomes:

$$L_{aggC1} = L_{aucEnteringUWWTP} \qquad (6)$$

L_{aggC1} the generated load entering the CS, in p.e.;

$L_{auc\ EnteringUWWTP}$ the load entering the UWWTP, in p.e.;

There are two possible cases for determining the generated load connected to CS, depending on the UWWTP availability and sufficiency of inlet monitoring data, see **Figure 19**.

Case 1: There is an existing UWWTP with sufficient inlet monitoring data base concerning the inlet loads (i.e. sufficient daily data about inlet flow and inlet BOD5 concentrations) – the load connected to CS (L_{aggC1}) is the sum of the load entering the UWWTP and the load collected through CS, but not (currently) treated in the UWWTP;

Case 2: There is a UWWTP with insufficient inlet monitoring data base concerning the inlet loads (e.g. there are no sufficient daily data about inlet flows and BOD5 concentrations) or there is no UWWTP – the load connected to CS (L_{aggC1}) is calculated as the sum of the loads of different groups of emitters.

Case 1: There is UWWTP with sufficient inlet monitoring data

28. The load generated by all the emitters connected to the UWWTP (Lauc EnteringUWWTP) is assessed pursuant to Art. 4(4) of the UWWTD, i.e. *"on the basis of the maximum average weekly load entering the treatment plant during the year, excluding unusual situations such as those due to heavy rain"* . This necessitates that the existing UWWTP has sufficient monitoring data at the inlet.

The UWWTD has no specific definition for "sufficient" data, as long as the mathematical calculation of "maximum average weekly load" requires having at least two samples per week (i.e. about 104 samples per annum). In addition, the standard monitoring practice assumes that:

- The BOD_5 sample shall be 24h mixed or proportional;
- The BOD_5 shall be determined in accredited laboratories.

For each UWWTP, graphs showing the trends of wastewater flows, the BOD_5 concentrations and BOD_5 loads will be prepared and analyzed in terms of:

- Is the trend smooth and does it assume reliability of the monitoring data (i.e. whether the majority of monitoring data fall into a specific range of values or there is a great difference in the values);
- Evidence for unusual events (e.g. extreme rainfall or other events), where the monitored values (flows or concentrations) are unusually high. Some daily values

might be excluded in this case, pursuant to the recommendations of Art. 4(4) of the UWWTD.

In **Annex 4: Examples on sufficient and insufficient WWTP inlet monitoring data** some examples on sufficient and insufficient monitoring data at the inlet of WWTPs are provided.

If the samples at the inlet are in the range of 24 to 103 in number, apparently average weekly load cannot be calculated for each week. Then it is proposed the generated load connected to the UWWTP to be determined as the 95th percentile of the inlet UWWTP loads, calculated based on the monitoring data and assuming that the trend of BOD_5 concentrations and respective loads are presentative. The samples should be 24h average daily or flow proportional.

If the monitoring samples at the inlet are less than 24 per annum, the monitoring database is considered to be insufficient to apply Art. 4(4) of the UWWTD, therefore for such cases the load entering the UWWTP will be determined as sum of the load of the respective groups of emitters.

Case 2: There is UWWTP with insufficient inlet monitoring data or there is no UWWTP

29. In this case the load connected to the CS is calculated as follows:

$$L_{aggC1} = L_{\mathrm{aggC1,NoEnt.UWWTP}} = L_{aggC1,PR} + L_{aggC1,NonPR} + L_{aggC1,IND} \qquad (7)$$

L_{aggC1}	the generated load entering the CS, in p.e.;
$L_{aggC1,\ NoEnt.UWWTP}$	the load collected through CS, but not treated in the UWWTP in p.e.;
$L_{aggC1,\ PR}$	the generated load of usual resident population connected to CS, in p.e.;
$L_{aggC1,\ Non\ PR}$	the generated load of non-permanent residents connected to CS, in p.e.;
$L_{agg\ C1,\ IND}$	the generated load of industrial emitters connected to the CS, in p.e.;

GENERATED LOAD OF USUAL RESIDENT POPULATION CONNECTED TO CS, ($L_{AGGC1,PR}$)

30. Based on the general assumption that the load of 1 resident is equal to 60 g BOD5/cap/d and that 1 p.e. = 60 g BOD5/cap/d (Art. 2 of the UWWTD). The generated load (in p.e.) of residents connected to CS (LaggC1,PR), as value, is equal to the number of permanent residents:

$$L_{aggC1,PR} = PR_{aggC1} \qquad (8)$$

$L_{aggC1,PR}$	the generated load of resident population connected to CS, in p.e.;
PR_{aggC1}	number of usual resident population connected to CS;

The determination of this load demands information on the usual resident population connected to CS. Credible information on the residents that benefit from the wastewater services provided by the Water Operator is essential for determination of this parameter.

The practice in Romania is that the Operator signs a contract with physical bodies (e.g. owners of family houses) or with Associations, representing condominiums (e.g. one or group of residential blocks). During discussion with several regional WSS Operators, it became obvious that there are no "ready to be used" figures concerning the number of residents connected to CS. Some operators (e.g. APA NOVA in IASI) have data concerning the number of dwellings in the condominiums; others (e.g. APA Brasov) cannot provide such information but can provide information on the number of connected family houses.

Based on the collected information concerning the management of wastewater services and data availability, the following specific assumptions were made:

1) All residential blocks are connected to CS (the interviewed WSS Operators confirmed that this is the common case);
2) The not-connected residents to CS live in detached or semi-detached family houses;
3) There is only one family, living in detached or semi-detached house;
4) The average number of residents in family houses is equal to the average number of residents per dwelling in the condominiums;

Therefore, the number of residents connected to collecting system can be determined through the following equations:

$$TNDW_{aggC1} = NDW_{cond} + NFH_{aggC1} \quad (9)$$

$$TNDW_{aggC1} * PR_{DW,2018} = PR_{aggC1} \quad (10)$$

$TNDW_{aggC1}$ total number of dwellings (condominiums and family houses) connected to the collecting system.

NDW_{cond} the number of dwellings in the condominiums *(information to be provided by the county/municipal administration or NSI);*

NFH_{aggC1} the number of family houses connected to collecting system *(information to be provided by the WSS Operator, based on individual contracts);*

$PR_{DW,2018}$ average number of residents per dwelling in 2018 in urban/rural areas calculated as the respective total number of usual residents in urban/rural areas is divided by the total number of households in the area (using NSI database);

PR_{aggC1} number of resident population connected to the sewer collecting system;

THE GENERATED LOAD OF NON-PERMANENT RESIDENTS CONNECTED TO CS ($L_{AGGC1, NON PR}$)

31. 47 localities have been defined as places of tourism with national significance and 61 localities have been further defined as places of tourism with regional significance according to Romanian Government's Decision 852/2008.

The Methodology assumes that:

- All the tourist facilities are included within the agglomeration boundaries;

- The non-permanent residents in settlements which are not resorts will be reflected only in case there is specific information about them at the level of agglomeration provided to the team (e.g. military campus, significant number of seasonal workers). Such information will be dealt with on a case by case basis.

In the common case, when the non-permanent residents are tourists, the respective load (expressed in p.e.), as value, is equal to the maximum average daily number of tourists in high season, based on the general assumption that the load of 1 tourist is equal to 1 p.e.

$$L_{aggC1,Non\,PR} = Non\ PR_{aggC1} \quad (11)$$

$L_{aggC1,Non\ PR}$ the generated load of tourists connected to CS expressed in p.e.;

$Non\ PR_{aggC1}$ number of non-permanent residents connected to CS;

The Romanian NSI collects monthly statistical data about the tourism accommodation establishments with an existing capacity of at least 10 bed-places at ATU level. Data will be collected from the NSI[15], on the maximum monthly number of overnights spent in high season, in year 2018. The maximum average daily number of tourists is calculated for large resorts assuming continuous tourists flow in high season as the maximum monthly value of overnights spent will be divided by 20 to 30 days. For small resorts, assuming mostly weekend tourist flow, the maximum monthly number of overnights spent will be divided by 8 to 12 days.

$$\mathrm{NonPR_{aggC1}} = \frac{\mathrm{MAX(NonPR_{month})}}{ND_{month}} \quad (12)$$

$NonPR_{aggC1}$ maximum average daily number of tourists in high season in 2018 (source: NSI);

$MAX(NonPR_{month})$ maximum number of tourists per month in high season;

ND_{month} number of days in the month tourist flow;

If within an ATU there is more than one resort settlement and they belong to different agglomerations, the tourist flow will be distributed based on expert assessment, depending on the size of the resorts.

For the national resorts, which are not settlements, depending on the existing information (e.g. monthly or annual data of spent overnights, or number of hotels) analyses would be made concerning the average daily number of tourists in the most intensive month based on information from Master Plans, Regional Feasibility Studies or county administration.

[15] Data Source: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table, FILE: TUR105H - Staying overnight in the establishments of touristic reception by counties and localities, monthly.

For these resorts, the maximum daily number of tourists will be increased by 10 percent to count for the servicing personnel, if there is no specific data on it.

GENERATED LOAD OF INDUSTRIAL EMITTERS ($L_{AGGC1, IND}$)

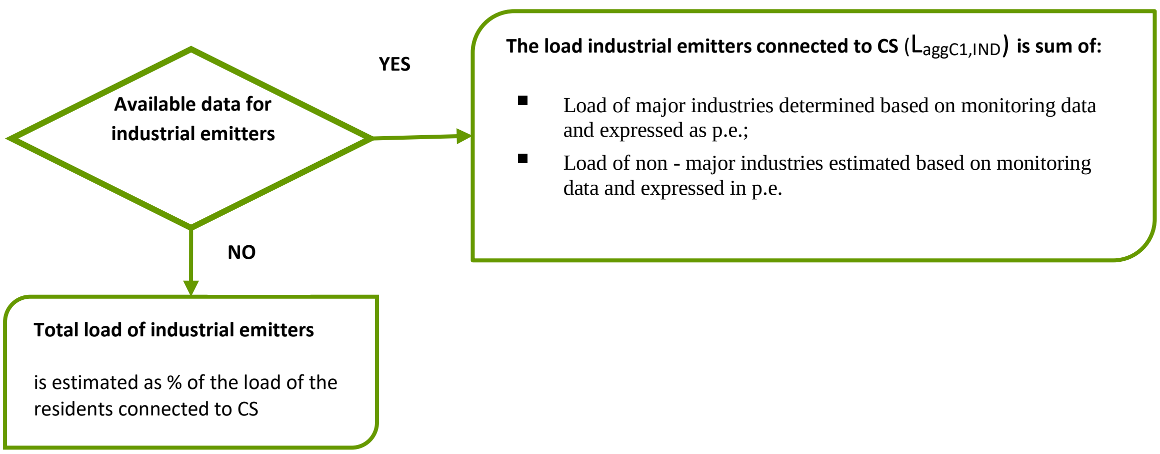
32. Following the "polluter pays" principle (Art. 9 of the WFD), the WSS Operators execute regular monitoring on the quality of industrial wastewater of the bigger industrial emitters that discharge into the sewer network. The BOD_5 concentration and flows are common parameters for monitoring of the industrial emitters whose production activities assume organic pollution (e.g. the food processing industries).

The frequency of monitoring depends on the size of the industrial emitters, as for the major industries within the settlement it may be performed 12 times per annum or less frequent. There is no however unified criterion for "major" industrial emitter. For the purpose of load calculation, the Methodology assumes that:

- "Major" industries are those, which contribution in terms of wastewater flow ($Q_{WW, IND}$) is above 1 percent of the total accounted dry weather wastewater flow of an agglomeration ($Q_{WW, AGG}$). The latter one is a sum of the accounted wastewater from the residents, non-residents, public facilities and industrial users.
- "Non-major" industries are those, whose contribution in terms of wastewater flow is below 1 percent of the total accounted dry weather flow of an agglomeration. Usually they are not subject to specific monitoring;

In the specific case where there is no UWWTP (or no sufficient inlet monitoring data) the following approach will be applied concerning the generated load of the industrial emitters connected to CS, see **Figure 20**:

Figure 20: Calculation algorithm for determining the industrial load connected to CS ($L_{aggC1,IND}$)



Source: WB elaboration for this report

The load of major and non-major industries will be calculated based on the monitoring data performed by the WSS Operators (see **Figure 20**) in case the database is representative.

In case there is no available data concerning the connected industrial emitters, the industrial load discharged into the collecting system will be calculated as percentage of the population and tourist loads. The percentage factor will depend on the number of residents and tourists and will be specified after processing all the data collected from the UWWTPs.

3.7 Generated load of agglomeration addressed by IAS (L_{aggC2})

33. According to the UWWTD legal compliance assessment methodology document[16], issued June 20, 2014, "*The fraction of waste water addressed through IAS is generally assessed as in compliance with Article 3 of the Directive. In line with the meaning of the acronym IAS, these systems are considered as "appropriate" by default, but with the constraint that this compliance is also considered as "questionable", unless more detailed information on IAS is made available by EU-MS.*"

34. Although there is no national requirement and a specified process of registering IAS in Romania, local, decentralized wastewater management solutions (e.g. cesspits, waterproof tanks) are common practice in areas, where there is no collecting system. In settlement areas not connected to CS the generated load is predominantly of domestic origin. Therefore, based on the observed situation and some expert assessments, we consider that it is predominantly residents living in such zones that form the load not addressed by the CS.

Based on field visits data and above-mentioned assessment, it can be assumed that the entire load not connected to CS is addressed by IAS when there is a centralized water supply. Therefore, the load addressed by IAS is assessed as:

$$PR_{agg\ 2018} - PR_{aggC1} = PR_{aggIAS} \qquad (13)$$

$$L_{aggIAS} = PR_{aggIAS} \qquad (14)$$

$PR_{agg,\ 2018}$ total number of resident population of the agglomeration in year 2018 (see Eq. 4)

PR_{aggC1} number of resident population connected to the sewer collecting system (see Eq. 10);

$PR_{agg\ IAS}$.. number of usual resident population addressed by IAS;

L_{aggIAS} the generated load not connected to CS, expressed in p.e.; equal, as a value, with the number of people in the respective zone;

If for a specific agglomeration the municipal authorities provide information that there are additional polution emitters (e.g. tourists) not currently connected to CS, their number, respectively load will be also taken into account.

[16] Specific Contract No. 07.0307/2013/SFRA/669101/ENV.C.2 implementing Framework Contract No. ENV.D.2/FRA/2012/0013

It should be noted that the industrial load not connected to the CS, which is treated and discharged separately subject to specific permissions, is not considered as a part of the generated load of the agglomeration[17].

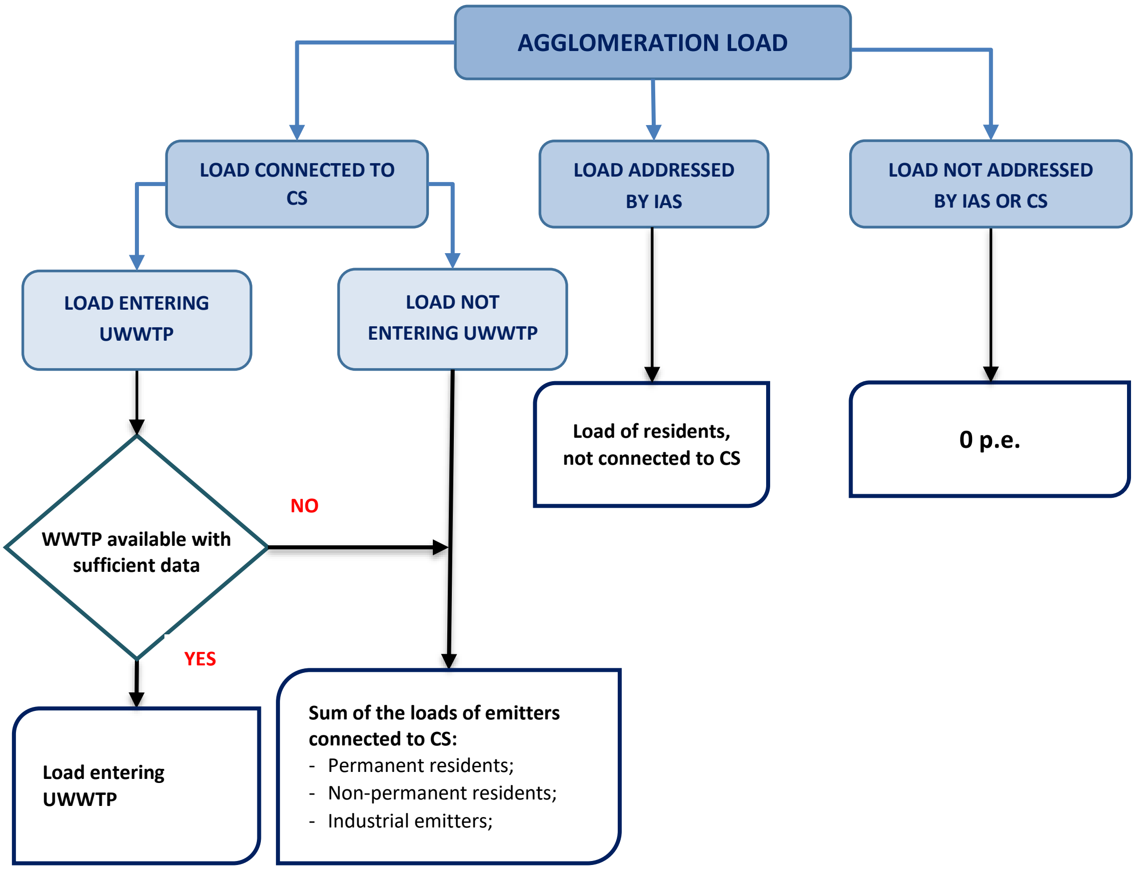
3.8 Generated load of agglomeration not collected by collecting system and not addressed by IAS ($L_{aggWithoutTreatment}$)

35. As mentioned in the paragraph above if there is a load not connected to CS it is addressed by some form of individual systems. Whether such systems are IAS that is a different topic as well as what the WB team is proposing as a solution for Romania, which described in detail in **Chapter 4.** The existing situation should be treated as temporary and a long-term solution following the recommendations in this report need to be put in place in the next few years.

3.9 Summary algorithm for calculation of the generated load of agglomeration

36. **Figure 21** presents the summary algorithm for calculating the generated agglomeration load.

Figure 21: Summary algorithm for determination the generated load of the agglomeration



Source: WB elaboration for this report

[17] According to UWWTD-REP, the generated load of agglomeration *"does not include the load of unmixed industrial waste water which is treated separately and directly discharged into waters."* http://ec.europa.eu/environment/water/water-urbanwaste/info/pdf/terms.pdf

3.10 Calculation of specific rates of generated load

37. The current requirements for reporting compliance with Art. 15 of UWWTD ask for providing information on rates of generated load of agglomeration (% of p.e.) instead on absolute loads (in p.e.). The following rates shall be presented, reflecting:

- generated load collected through CS; *parameter aggC1*
- generated load collected through CS and treated in UWWTPs; parameter *aucPercEnteringUWWTP*
- generated load addressed through IAS; *parameter aggC2*
- generated load which is not collected at all (i.e. not collected through collecting system and not addressed through IAS; *Parameter aggPercWithoutTreatment*

The following equality is in effect:

$$aggC1 + aggC2 + aggPercWithoutTreatment = 100\% \qquad (15)$$

RATE OF GENERATED LOAD OF AGGLOMERATION COLLECTED THROUGH COLLECTING SYSTEM (AGGC1)

$$aggC1 = \frac{L_{aggC1}}{aggGenerated} .100 \qquad (16)$$

aggC1 rate of generated load of agglomeration collected through collecting system %;

L_{aggC1} generated load of agglomeration collected through collecting system in p.e.;

aggGenerated generated load of the agglomeration in p.e.;

RATE OF GENERATED LOAD OF AGGLOMERATION ENTERING PARTICULAR PLANT (AUCPERCENTERINGUWWTP)

$$aucPercEnteringUWWTP = \frac{L_{aucEnteringUWWTP}}{aggGenerated} .100 \qquad (17)$$

aucPercEnteringUWWTP rate of generated load of agglomeration collected through collecting system and entering UWWTP %;

$L_{aucPercEnteringUWWTP}$ generated load of agglomeration collected through collecting system and entering the UWWTP in p.e.;

aggGenerated generated load of agglomeration in p.e.

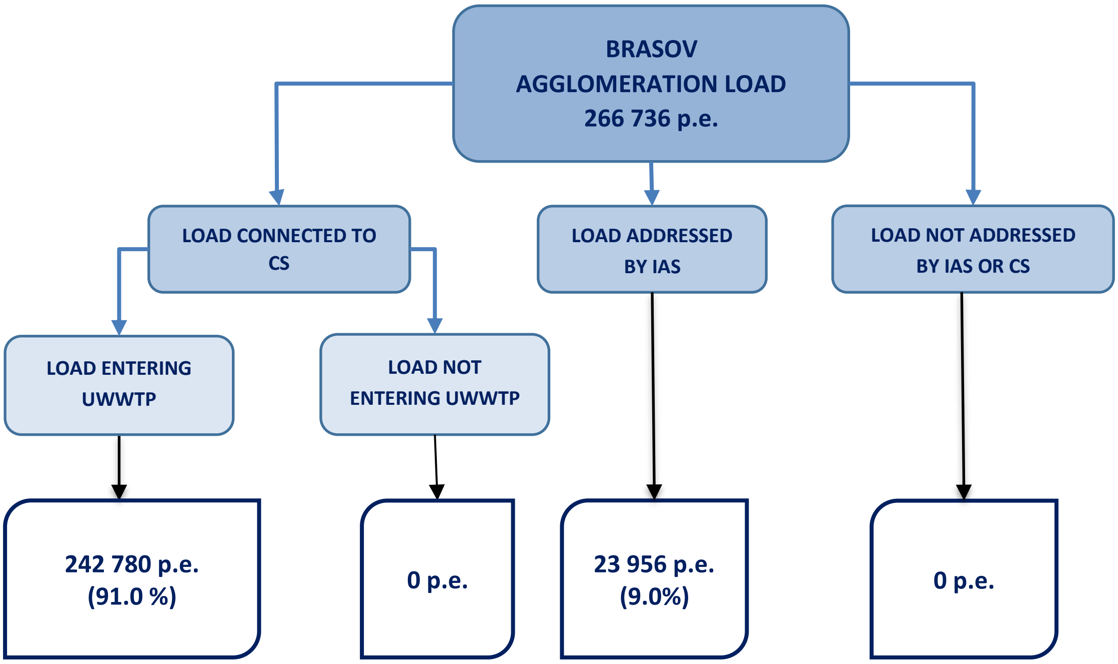
3.11 Examples for determination of pollution load

Two examples are provided from the pilot Brasov county: Brasov agglomeration and Codlea agglomeration are presented below for determining the generated load based on the methodology for calculation of pollution load.

BRASOV AGGLOMERATION

- Brasov agglomeration includes the following settlements: Brasov, Ghimbav, Sanpetru and Sacele.
- The generated load collected through the CS is treated in WWTP Brasov, which services the following settlements: Brasov, Cristian, Ghimbav, Harman, Rasnov, Sacele, and Sanpetru. All collected load through CS is treated in WWTP Brasov.
- WWTP Brasov has sufficient inlet monitoring data base at the inlet, as for year 2018 there are 135 average daily samples. The load of the WWTP Brasov is determined as the maximum average weekly value of the period and it is calculated to be 268 637 p.e. The load is distributed among the serviced settlements based on the percentage contribution of each settlement in terms of population and tourists connected to CS.
- The key parameters concerning the generated load within Brasov agglomeration are presented on **Figure 22**.

Figure 22: Key components of the generated load for Brasov agglomeration



Source: WB elaboration for this report

Table 5: Comparison between the generated load of Brasov agglomeration determined through the methodology and reported by ANAR in the last compliance report

Data Source	**Settlements included**	**Agglomeration load** *aggGenerated*	**Load connected to CS,** *(aggC1)*		**Load connected to IAS,** *(aggC2)*		**Load, not adressed by CS and IAS** *(WithoutTreatment)*	
		p.e.	**p.e.**	**%**	**p.e.**	**%**	**p.e.**	**%**
Methodology	Brasov, Ghimbav, Sanpetru, Sacele	**266,736**	242,780	91.0	23,956	9.0	0	0
ANAR Data base	Brasov, Poiana Brasov, Sacele, Tohanu Nou	**398,604**	369,905	92.8	0	0	28,699	7.2
Difference		**-33%**						

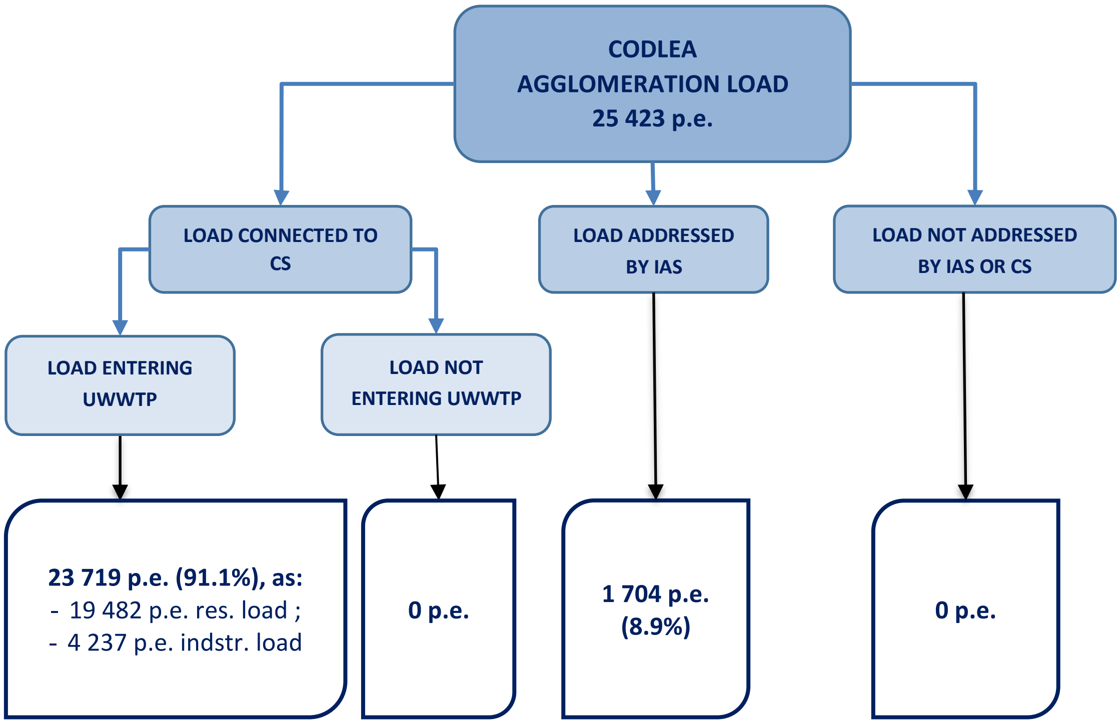
The calculated agglomeration load is about 33% less than the last reported load. The reasons for the difference are due to: 1) change of the agglomeration boundaries and 2) more accurate calculation of the pollution load, i.e. based on inlet monitoring data of WWTP Brasov.

The population within the Brasov agglomeration is 285 442 residents. The calculated load is slightly lower, i.e. it is 94% of the resident population. This is because real, monitoring data have been used for load calculation, instead of estimations based on specific loads. Such a result is common when using real monitoring data.

CODLEA AGGLOMERATION

- Codlea agglomeration includes Codlea settlement.
- The generated load collected through the CS is treated in WWTP Feldioara, which services the following settlements: Codlea, Feldioara and Halchiu. All the load collected through CS is treated in WWTP Feldioara.
- WWTP Feldioara has not sufficient monitoring data base at the inlet, as for year 2018 there are 18 samples, some of them grab samples. Therefore, the data base is not considered representative for determining the generated load on the basis of maximum average weekly load.
- As a result, the generated load of the agglomeration has been determined as sum of the loads of different groups of emitters. In addition, the data base concerning the industrial emitters is also not sufficient to determine the industrial load. Therefore, the contribution of the industrial load is estimated as 20 percent of the population load;
- The key parameters concerning the generated load within Codlea agglomeration are presented on **Figure 23**.

Figure 23: Key components of the generated load for Codlea agglomeration



Source: WB elaboration for this report

Table 6 Comparison between the generated load of Codlea agglomeration determined through the methodology and reported by ANAR in the last compliance report

Data Source	Settlements included	Agglomeration load *aggGenerated*	Load connected to CS, *(aggC1)*		Load connected to IAS, *(aggC2)*		Load, not adressed by CS and IAS *(WithoutTreatment)*	
		p.e.	p.e.	%	p.e.	%	p.e.	%
Methodology	Codlea	**25,423**	23,719	91.1	1,704	8.9	0	0
ANAR Data base	Codlea	**30,820**	30,204	98	0	0	616	2
Difference		**-18%**						

The difference in the generated load is less than 20 percent mainly as a result decreased size of the agglomeration. The new agglomeration boundary encompasses only the sufficiently concentrated area.

More detailed information about the calculation of the loads of Brasov and Codlea agglomerations is provided in

Annex 5: Calculation of the pollution loads of Brasov and Codlea agglomerations

3.12 Required database

38. As mentioned above, the determination of the generated agglomeration load demands sufficient data base to be collected from different sources. Only reliable sources of information will be used, i.e.

- the Romanian National Institute of Statistics concerning data on the usual resident population development in 2011 and 2018, as well as data about the number and type of dwelling in the settlements that fall within agglomerations' boundaries;
- data from the WSS Operators (regional and local operators) requested through the MoEWF and ANRSC regarding provision of wastewater services. Questionnaires (data base template) to be filled are presented in **Annex 3: Questionnaires to WSS operators**.

Chapter 4. Application of Individual Appropriate Systems (IAS)

4.1 Requirements at EU and national levels

39. Article 3(1) of Council Directive 91/271/EEC concerning urban wastewater treatment stipulates the application of Individual systems or other appropriate systems (IAS) as an alternative to centralized collecting systems where *"the establishment of a collecting system is not justified either because it would produce no environmental benefit or because it would involve excessive cost".* However, the requirement is that IAS achieve the same "level of environmental protection" as a collecting system. To ensure this the European Committee for Standardization (CEN) has introduced EN12566 series of IAS standards. The latest editions of these are:

- *EN 12566-1:2017 Small wastewater treatment systems for up to 50 PT Part 1: Prefabricated septic tanks;*
- *EN 12566-3:2017 Small wastewater treatment systems for up to 50 PT Part 3: Packaged and/or site assembled domestic waste water treatment plants;*
- *EN 12566-4:2017 Small wastewater treatment systems for up to 50 PT Part 4: Septic tanks assembled in situ from prefabricated kits;*
- *EN 12566-6:2017 Small wastewater treatment systems for up to 50 PT Part 6: Prefabricated treatment units for septic tank effluent;*
- *EN 12566-7:2017 Small wastewater treatment systems for up to 50 PT Part 7: Prefabricated tertiary treatment units;*

The above standards are complemented by:

- *EN 16323:2014: Glossary of wastewater engineering terms;*
- *CEN/TR 12566-2:2005: Small wastewater treatment systems for up to 50 PT – Part 2: Soil infiltration systems;*
- *CEN/TR 12566-5:2010: Small wastewater treatment systems for up to 50 PT – Part 5: Pre-treated effluent filtration systems.*

The Romanian water supply and sanitation legislation does not provide a systematic regulation of the IAS. Several laws, bylaws, design norms and standards include requirements for design and construction of IAS, while the requirements for operation and maintenance are succinct. Romania has adopted the above series of standards *excluding CEN/TR 12 566-2:2005 - Part 2: Soil infiltration systems and CEN/TR 12566-5:2010 - Part 5: Pre-treated effluent filtration systems.* According to the regional water operators, different individual systems are in use, based on various specifications for each product/system.

The term "IAS" as used in this report means any individual and other appropriate system for wastewater storage and/or treatment when a collecting system is not available. Each EN 12566 standard includes requirements for an individual treatment unit and some of them cannot be used as a single treatment solution, while, IAS is a complete system for wastewater treatment or storage meeting the environmental objectives. IAS could be either one single standard unit, their combination, or any other appropriate system not yet standardized. One non-standardized system is a water tight pit (IAS 4, **Annex 1: Data used for calculation of CAPEX for collecting networks (FS for LIOP financing)**). It only stores wastewater temporary and is used where it is not possible to discharge wastewater into water body or soil.

4.2 Applicability of IAS in Romania

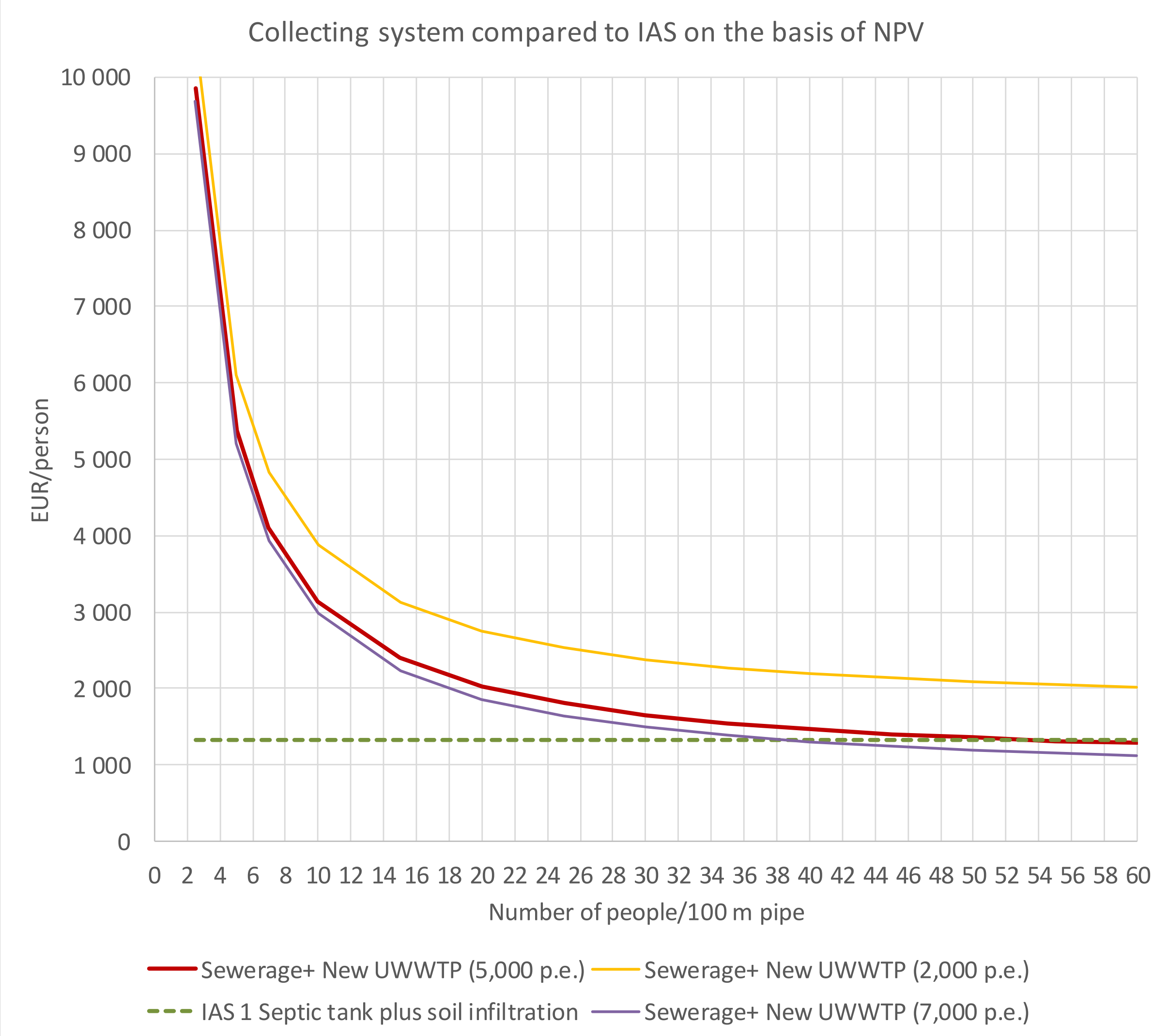
40. As pointed out in the text above, the use of IAS inside agglomeration boundaries is arranged by Article 3(1) of the UWWTD. It enables the use of IAS provided that: a) they are a cheaper option compared to a centralized collecting system and b) they achieve the same level of environmental protection as centralized collecting systems. The use of IAS in settlements below 2,000 p.e. or outside agglomeration boundaries is not regulated by the UWWTD. Regardless of the settlement size, when there is not CS IAS have their specific niche of applicability. However, within agglomeration boundaries they should be used only when the engineering assessment based on multi-criteria screening (technical, financial, environmental, engineering) demonstrates they are justified in comparison to centralized collecting systems.

41. A financial criterion was applied to outline roughly the range of applicability of IAS inside agglomeration boundaries in Romania. Earlier in this report, it was clarified that agglomeration without collecting systems are almost exclusively below 10,000 p.e., which is why the analysis was done for such agglomeration sizes. Three sizes agglomeration were compared: 2,000 p.e.; 5,000 p.e. and 7,000 p.e., and in all of them it was assumed that both a collecting system and a WWTP should be constructed since there is none. No big industrial pollutants were added, i.e. the number of p.e. is in most of the cases equals to the population number in line with the findings from the field visits. If there are industrial activities, the number of people will be smaller, i.e. there will be higher costs per person for the construction and operation of the collecting system and the UWWTP. Thus, such scenarios will not change the conclusions.

    CAPEX for the collecting system and WWTP were calculated based on information on historical project costs and estimated project costs from FS financed under LIOP (provided in **Annex 2: Data used for calculation of CAPEX for small UWWTP (FS for LIOP financing)1** and **Annex 3: Questionnaires to WSS operators2** of this report). Data from 96 projects for the collecting system and 45 projects for WWTPs were used. CAPEX and OPEX of the IAS were calculated based on the market prices in Romania (see **Annex 4: Examples on sufficient and insufficient WWTP inlet monitoring data6**).

The results are visualized in the **Figure 24** below.

Figure 24: Collecting system (network and UWWTP) compared to IAS1 on the basis of NPV



Source: WB elaboration for this report

This figure shows that when both collecting system and WWTP should be constructed:

In agglomerations above 2,000 people: IAS1 (see

- **Annex 5: Calculation of the pollution loads of Brasov and Codlea agglomerations6** for detailed explanations) is always going to be cheaper than building a CS and a WWTP;
- Agglomerations below 5,000 people: building a CS and a WWTP will be a cheaper option only when there are more than 53 people connected to 100 m. of pipe. If detached houses are assumed, 53 people/100 m. (or 20 houses[18]/100 m pipe) means approximately plots with width smaller than 10 m (face on the road), which is quite rear in Romania. Therefore, for settlements below 5,000 people with detached houses IAS will most probably be a cheaper option.
- Agglomerations above 5,000 people: most probably a building a CS and a WWTP will be a cheaper option. The curve for agglomeration of 7,000 p.e. shows that IAS is cheaper if population density is below 38 people (14 houses per 100 m pipe), which is not that common in settlements of this size in Romania.

Even though the calculations were done using relatively high number of recent Romanian projects and correlations were good, the conclusions above are nonconclusive. Prior to making a final recommendation and a decision on whether IAS or a collecting system should be constructed, each specific case should be thoroughly analyzed at the FS stage. The financial considerations, discussed above, should be combined with other criteria – environmental, social, etc. As already mentioned in **Chapter 3.** if there is no CS the load is addressed by some individual system. However, whether most of the existing systems are IAS that provide the same level of environmental protection is questionable and that is what we refer to when discussing investments in IAS and associated process to monitor their performance.

With regard to the environmental considerations when comparing IAS with the centralized collecting system, it should be noted that based on the requirements of the Water Framework Directive (WFD) and the associated national regulations, a Registry of Protected Areas should identify those areas, which require special protection, either protection of surface water or groundwater, or to conserve habitats or species that depend on those waters, including:

- Nutrient Sensitive Areas;
- Waters used for the abstraction of drinking water;
- Areas designated to protect economically significant aquatic species;
- Bathing/Recreational Waters;
- Areas designated for the protection of habitats or species where maintaining or improving water status is an important factor, including sites relevant to the Natura 2000 network designated under Directive 92/43 /EC and Directive 79/409/EEC, etc.

All of the above-mentioned requirements are dully taken into account in Romania.

[18] Using 2.67 people/house, NSI, census 2011

Other possible criteria, which would result in preferring collecting system to IAS despite the cost-related criteria are:

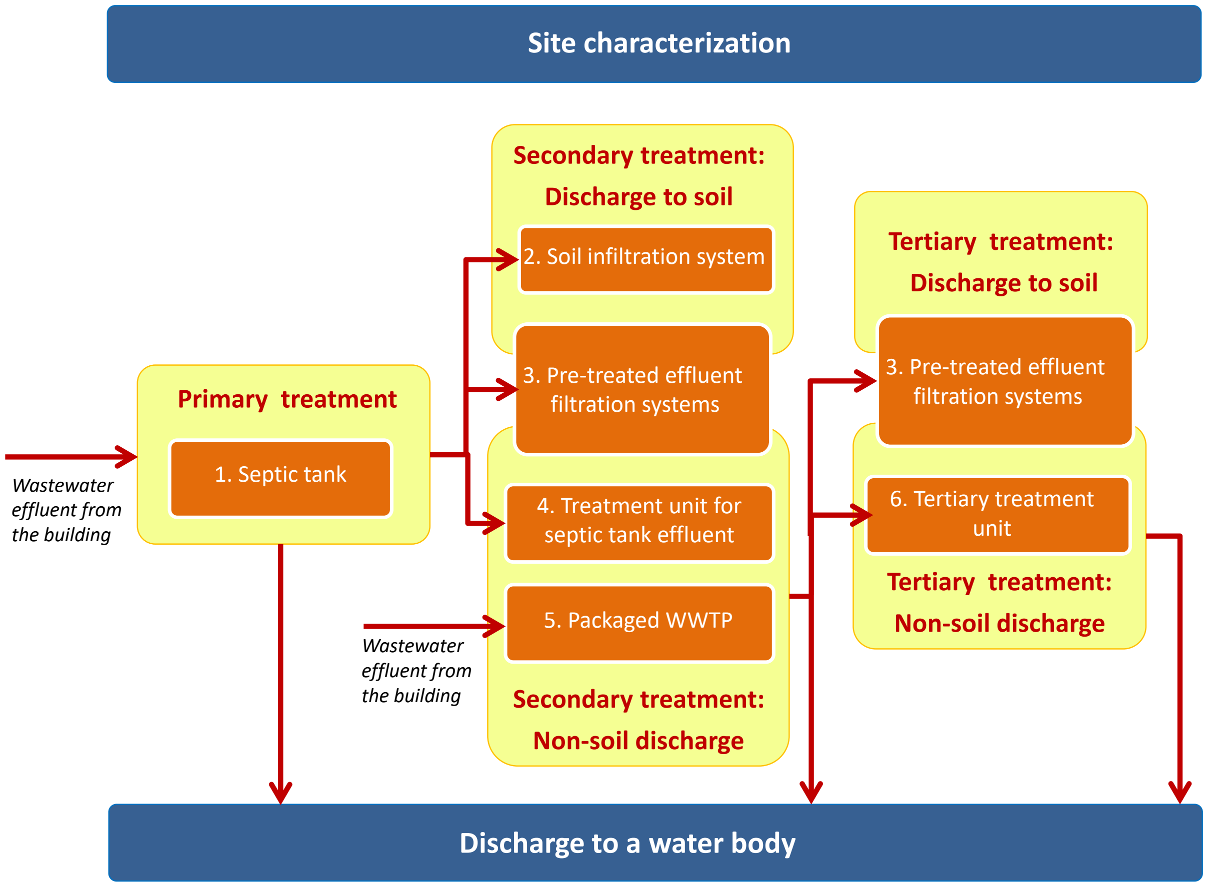
- impermeable soil and no possibility for discharge of treated wastewater;
- landslides zones, where discharging into the soil increases the risk of landslides;
- high ground water table, which does not allow infiltration pipes to be constructed etc.

However, those are exceptions, which need to be confirmed at FS stage. The Bank team will make an assessment and present different investment options for agglomerations below 5,000 p.e. for Romanian Government to make an informed decision about ways to optimize compliance costs and accelerate achievement of UWWTD requirements.

4.3 Selection of IAS

42. Based on the standardized IAS units, the discharge possibilities (soil or surface water body) and the requirements of the UWWTD the following summary scheme of treatment units and their combinations is proposed:

Figure 25: Summary of standardized IAS units, their combination, treatment levels and discharge possibilities



Source: WB elaboration for this report

Prior to taking a decision on selection of IAS, a site characterization should be undertaken to determine whether the plot (within built-up areas) is suitable or not for an on-site wastewater treatment system (as indicated in the top box of **Figure 25**).

The definitions of the treatment levels are provided in Article 2 of the UWWT Directive and further explanation is given below:

Primary treatment – This is the stage which corresponds to the primary treatment in the urban WWTP. Its purpose is to separate the solids part from the liquid. In general, this stage does not ensure sufficient treatment efficiency within agglomerations with exception of the conditions specified in the Directive (Art. 6 (1) and (2) apply, *i.e.* discharge to coastal areas or to "less sensitive areas") where the discharge does not adversely affect the environment. Normally the primary effluent should pass through further treatment levels. Only the septic tank is standardized as a treatment unit providing primary treatment level.

Secondary treatment – In this stage the organic pollution is also reduced. Nitrogen and phosphorus removal also occur to some (modest) extent. Depending on the environmental requirements and local conditions, this stage could be the final treatment stage, after which the effluent is discharged either to the soil or to a water body. If the environmental requirements are more stringent, this stage should be followed by a tertiary treatment (reference to Art. 5 of the Directive). Several treatment units have been standardized. Only packaged WWTPs may be used individually. All others require primary treatment.

Tertiary treatment – This stage provides additional treatment to wastewater from secondary treatment systems. Its role is to further reduce nutrients or the number of micro-organisms present in the treated wastewater. The treatment units, which are considered here, are appropriate also to ensure "more stringent secondary or tertiary treatment", which is required by other Directives.

When a decision is to be taken about the most appropriate IAS, several issues should be considered, the most significant being:

a. Environmental constraints (sensitive or normal or less sensitive area)

b. Discharge options (surface water body or ground)

c. Soil characteristics (mainly its permeability)

d. Available area

e. Total lifetime costs

Table 7: Summary of the selected IAS

Level of treatment	IAS	Soil characteristics	Land availability	Discharge options
Secondary	IAS 1: Septic tank plus soil infiltration system	Permeable	Land is available	Ground
Secondary	IAS 2: Septic tank plus pre-treated effluent filtration system	Permeable	Land is restricted	Ground

Level of treatment	IAS	Soil characteristics	Land availability	Discharge options
Secondary	IAS 3: Packaged WWTP	Any	Land is restricted	Surface water body
Tertiary	IAS 4: Packaged WWTP plus tertiary treatment with reed beds	Any	Land is available	Surface water body
Off-site[19]	IAS 5: Water tight tank	Impermeable	Land is restricted	No on-site discharge option

Detailed information on the IAS included in the table is provided in **Annex 4: Examples on sufficient and insufficient WWTP inlet monitoring data**

UWWTP BRASOV, BRASOV COUNTY

WWTP Brasov is an example for a treatment plant with sufficient inlet monitoring data, that allows calculation of maximum average weekly load within one year. This is in line with the requirements of Art. 4 (4) of the UWWTD. Monitoring data have been received by the WSS Operator for 2018. The data was processed as the summary results are represented below:

Figure 35: Inlet flow data at UWWTP Brasov

Figure 36: Inlet monitoring data for BOD5 concentrations at UWWTP Brasov

[19]Treatment level depends on the available treatment level of the recipient WWTP.

Figure 37: Results of calculate Inlet BOD5 load at UWWTP Brasov

Analyzing the data, with some small exceptions, there are smooth trends in the daily values for all the investigated parameters. It is obvious that there is an increase in BOD5 concentrations at the inlet, respectively in the BOD5 loads in the second half of October. The value on 4.10.2018 was excluded since it is exceptional in the period 1.10-6.10.2018, almost double than the other daily values in the week. The higher result may be due to an error either in the sampling or in the analytical measurements.

The values in the period 29.10 – 4.11. 2018 however were not excluded, although high, since there was no evidence in the inlet flow data that they are due to have rains. Furthermore, the values in all the week are high, which could be due to some excessive industrial pollution.

The available (i.e. meaningful values) information is summarized in the following table:

Table 12: Summary inlet monitoring results of UWWTP Gaesti

WWTP Brasov	Q	BOD5 max average weekly load
	m3/a	**kg/d**
Values	24 413 869	16 118
Nr samples	227	134

The maximum average weekly load of UWWTP Brasov, in p.e., is: 16 118/0.06 = **268 637 p.e.**

UWWTP Feldioara, BRASOV COUNTY

WWTP Feldioara is an example for a treatment plant with insufficient inlet monitoring data, which does not allow calculation of maximum average weekly load within one year (as per the requirements), although some monitoring data have been received by the WSS Operator for 2018. The data was processed, as the summary results are represented below:

Figure 38: Inlet flow data at UWWTP Feldioara

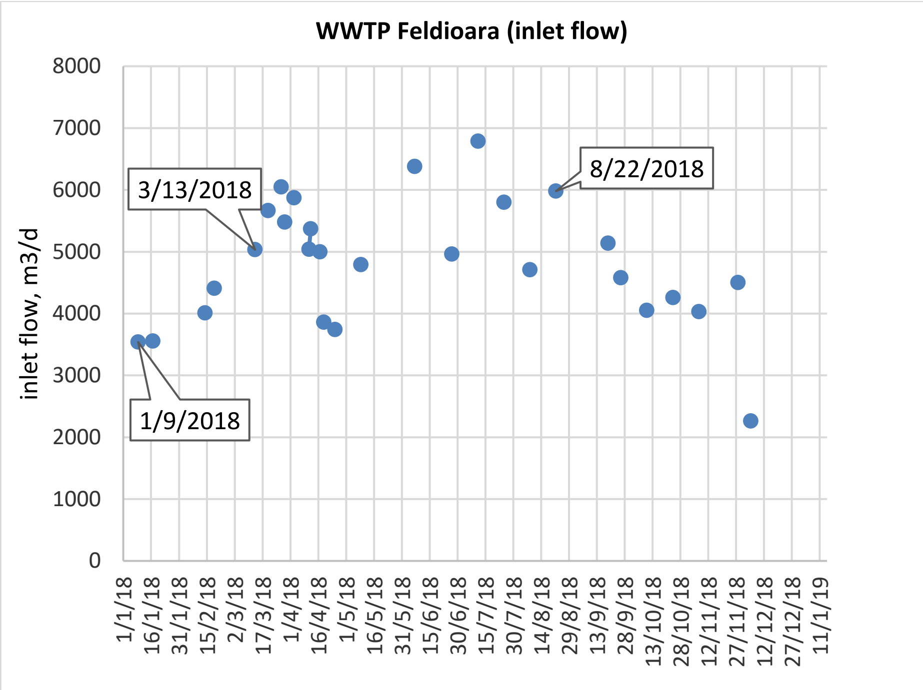
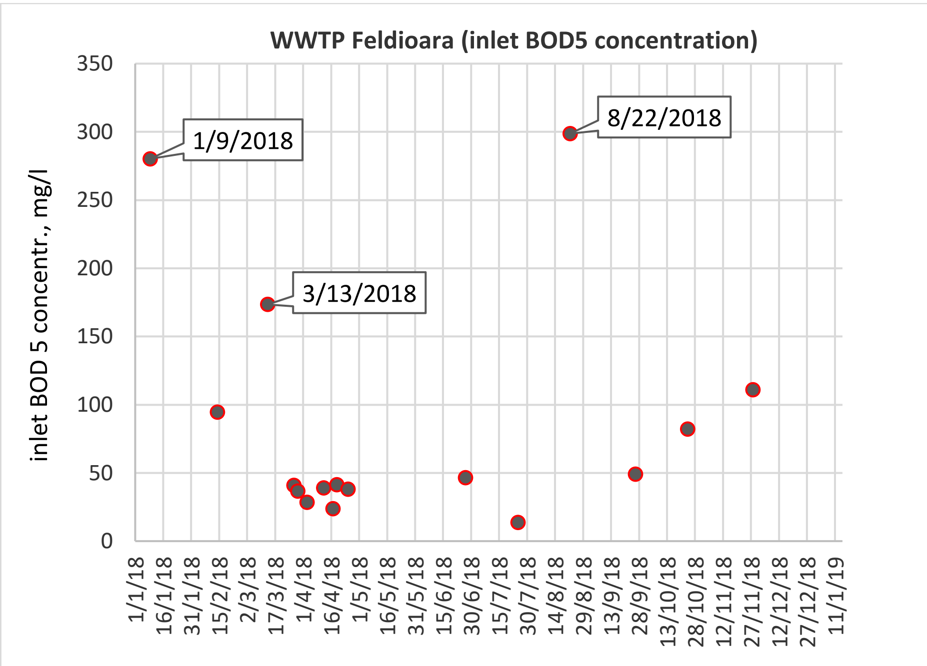


Figure 39: Inlet monitoring data for BOD5 concentrations at UWWTP Feldioara



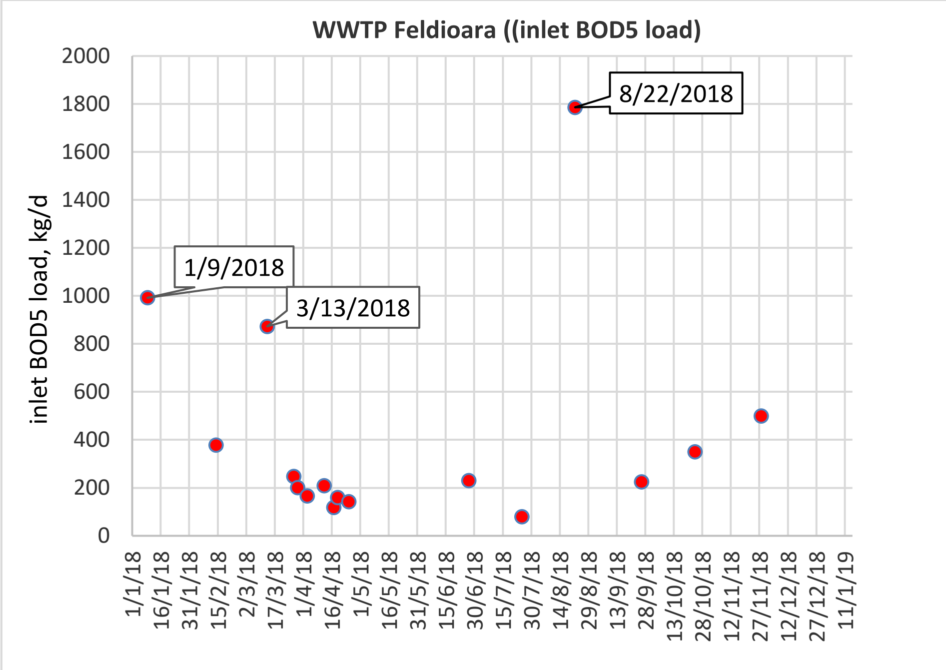


Figure 40: Results of calculate Inlet BOD5 load at UWWTP Feldioara

Analyzing the data, the inlet flow trend seems to be okay, although there is an evidence for seasonal irregularity, i.e. during the summer the flows seem to be higher. Analyzing the inlet BOD5 concentrations however, the values were very scattered with extremely high values on 9.01.2018, 12.3.2018 and 22.08.2018, which also reflect in extremely high BOD5 loads. There was no evidence that these values are due to extremely high rainfalls.

The available information is summarized in the following table:

Table 13: Summary inlet monitoring results of UWWTP Feldioara

WWTP Brasov	Q	BOD5 max average weekly load
	m3/a	kg/d
Values	1 757 944	1 191
Nr samples	28	16

The existing monitoring data base is too scarce to allow representative determination of the maximum average weekly inlet BOD5 load of UWWTP Feldioara.

UWWTP Insuratei, BRAILA COUNTY

WWTP Insuratei is an example for a treatment plant with sufficient inlet monitoring data, allowing allow calculation of maximum average weekly load within one year. Monitoring data have been received by the WSS Operator for 2018. The data are processed as the summary results are represented below:

Figure 41: Inlet flow data at UWWTP Insuratei

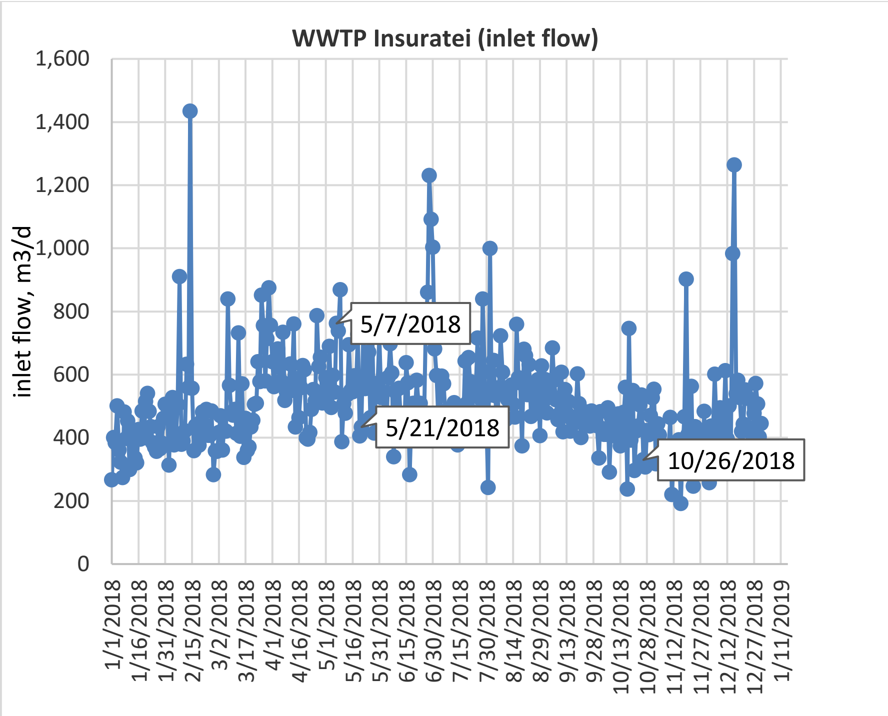
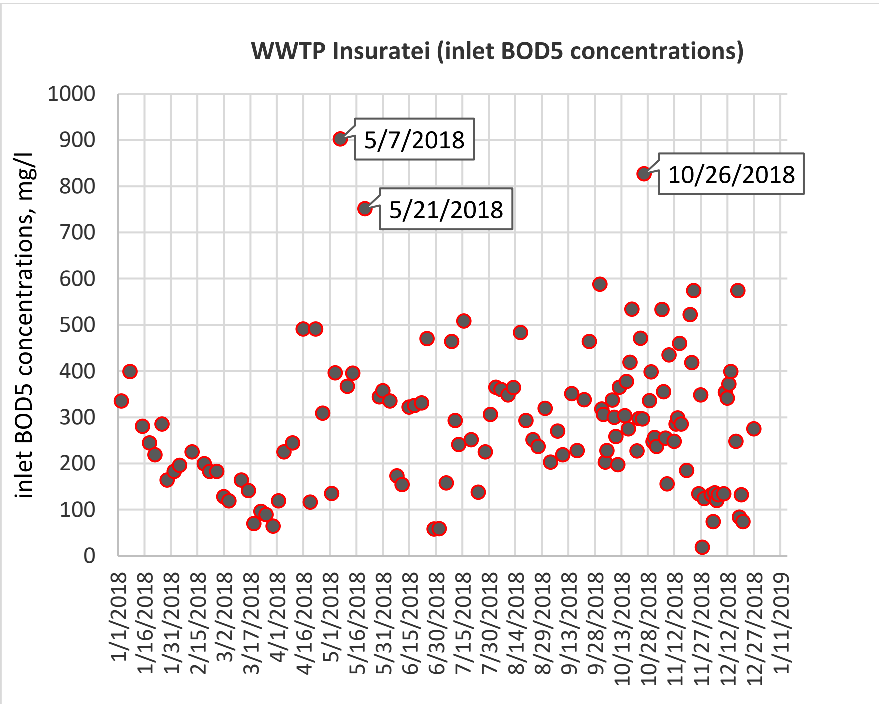


Figure 42: Inlet monitoring data for BOD5 concentrations at UWWTP Insuratei



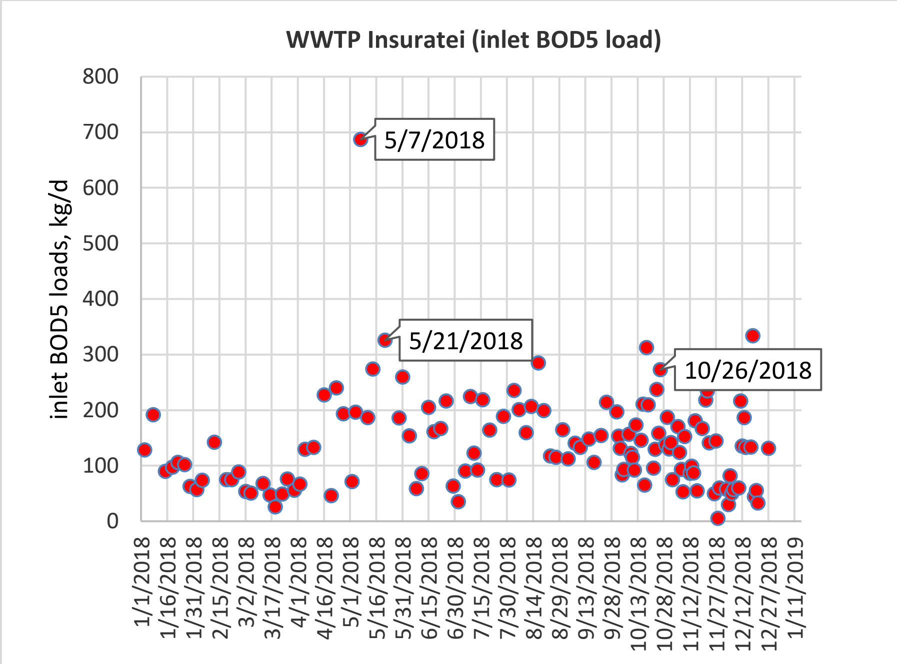


Figure 43: Results of calculate Inlet BOD5 load at UWWTP Insuratei

Analyzing the data, the inlet flow trend seems to be okay, although there is evidence for extreme rainfall events. There is no evidence however how the extreme rain events affect the inlet BOD5 concentrations and loads, since there was no monitoring data for inlet BOD5 concentrations during such events.

Analyzing the inlet BOD5 concentrations there are 3 extremely high values on 7.05.2018, 21.05.2018 and 26.10.2018, which are far beyond the range of all the other values. These values reflect also in high BOD5 loads. There was no evidence that these values are due to extremely high rainfalls. They can be due to random mistakes in sampling or analytical measurement. They are excluded from the data processing.

The available information is summarized in the following table:

Table 14: Summary inlet monitoring results of UWWTP Insuratei

WWTP Insuratei	Q	BOD5 max average weekly load
	m3/a	kg/d
Values	185 468	274
Nr samples	365	125

The maximum average weekly load of UWWTP Insuratei, in p.e., is: 274/0.06 = **4 569 p.e.**

Annex 5: Calculation of the pollution loads of Brasov and Codlea agglomerations

CALCULATION OF THE AGGLOMERATION LOAD FOR BRASOV AGGLOMERATION

1.1 Calculation of the usual resident population, as per 2018, in the Brasov agglomeration

Based on the newly delineated boundaries, Brasov agglomeration includes the settlements Brasov, Ghimbav, Sacele and SanPetru.

The usual resident population is determined according to Equation 3 (see details **in Chapter 3.**). The results are presented in **Table 15** below:

$$PR_{S,2018} = \frac{PR_{U/R,2018}}{PR\ U/R,2011}\ x\ PR_{S,2011}$$

(3)

Table 15: Calculation of usual resident population in 2018 for the settlements included in Brasov agglomeration

Settlements in Brasov aggl.	Total population ATU urban area, 2011 PRU/R,2011	Total population ATU urban area, 2018 PRU/R,2018	Total population in the settlement, 2011 PRS,2011	Total population in the settlement,2018 PRS,2018
	1	2	3	4
BRASOV	397,026	389,743	252,814	**248,176**
GHIMBAV	397,026	389,743	4,698	**4,612**
SACELE	397,026	389,743	30,798	**30,233**
SANPETRU	152,191	161,440	4,819	**5,112**

Source for columns 1, 2 and 3: NSI data base

The usual resident population within the agglomeration is determined according to Equation 4 (see details in **Chapter 3.**) and using information from the maps, about houses in the outskirts, which are not included within the boundaries (not "sufficiently concentrated").

The average number of residents per dwelling is calculated based on information by NSI, at county level, about the total number of dwellings in urban and rural areas (see details in **Table 16**).

$$PRAGG, 2018= (PRS1,2018–PREX,S1,2018)+(PRS2,2018–PREX,S2,2018)...+(PRSn,2018–PREX,SN,2018) + PR_{IN,Sn+1,2018}) \quad (4)$$

Table 16: Calculation of average number of residents per dwelling

Brasov county	Total usual res. population	Total number of dwellings, 2018	residents per house
	1	2	3
Total County	551,183	252,473	2.18
Total urban area	389,743	189,116	2.06
Total rural area	161,440	63,357	2.55

Source for columns 1, 2: NSI

The calculations are given in . The total number of usual resident population within the agglomeration is:

$$PR_{AGG,2018} = 288\ 133 - 2691 = \mathbf{285\ 442}$$

Table 17: Calculation of usual resident population within the agglomeration boundaries

Settlements	***PRS,2018***	***Average residents per dwelling***	***Excluded houses***	***Excluded population***	***Population within agg.boundaries***
	1	2	3	4	5
BRASOV	248,176	2.06	402	828	247,348
GHIMBAV	4,612	2.06	0	0	4,612
SACELE	30,233	2.06	367	756	29,477
SANPETRU	5,112	2.55	434	1,107	4,005
Total	**288,133**			**2,691**	**285,442**

Source for column 1: Table 15, column 4
Source for column 2: Table 16, column 3
Source for column 3: information from the agglomeration map

1.2 Calculation of the load collected by the sewer system (LaggC1)

In the case of Brasov agglomeration, all the generated load collected through the collecting system, enters WWTP Brasov, i.e. Equation 6 (see details in **Chapter 3.**).

$$L_{aggC1} = L_{aucEnteringUWWTP} \qquad (6)$$

<u>*Generated load of the agglomeration addressed by UWWTP Brasov*</u>

There is an existing UWWTP (i.e. WWTP Brasov) with sufficient inlet monitoring data, allowing calculation of the average maximum weekly load, se per requirement of Art. 4(4) of the UWWTD. The maximum average weekly load of UWWTP Brasov is determined to be 268,637 p.e. (see **Annex 4** for more details). The UWWTP services the following settlements (based on information by APA BRASOV): Brasov, Ghimbav, Rasnov, Sacele, San Petru, Cristian, Harman and Poiana Brasov. The contribution of each settlement to the UWWTP is assessed based on the number of usual residents and tourists (if such) connected to collecting system/UWWTP.

The population connected to UWWTP Brasov for these settlements is presented in **Table 18.**

In the specific case, Poiana Brasov is a small settlement (379 residents in 2018) with very intensive tourist activities throughout the year. According to the NSI data, the maximum number of tourists in Brasov municipality was 155,121 nr, realized in August 2018.

- It is assumed that all the tourists are in Poiana Brasov, thus the average daily number of tourists is: 155 121/30 **= 5 171 nr/day;**
- It is assumed that all the tourist facilities are connected to UWWTP Brasov;

- The connection rate of residents in Poiana Brasov to the UWWTP is evaluated to be the same as for Brasov city (see the explanations below), i.e. the connected residents are 361 people. Thus, the total number of population and tourists in Poiana Brasov connected to UWWP is:

361 + 5171 = **5 532** (residents + tourists)

Table 18: Distribution of the load of UWWTP Brasov among the serviced settlements

Settlements serviced by UWWTP Brasov	Population and tourists connected to CS/UWWTP	Load distribution, %	Load distribution as p.e.
	1	2	3
Brasov	**236,197**	**81.63**	**219,300**
Ghimbav	**4,076**	**1.41**	**3,784**
Rasnov	14,800	5.12	13,741
Sacele	**17,209**	**5.95**	**15,978**
San Petru	**4,004**	**1.38**	**3,718**
Cristian	3,620	1.25	3,361
Harman	3,897	1.35	3,618
Poana Brasov	5,532	1.91	5,136
Total		**100**	**268,636**

The Brasov agglomeration load, connected to the UWWTP Brasov is evaluated to be:

219 300+3 784+15 978+3 718 = **242 780 p.e.**

According to the WSS Operator, all the industries are connected to the UWWTP Brasov. Thus, the load of the industrial emitters is included within the load treated by UWWTP Brasov.

Connection rates

The connection rate of the population of each settlement to the sewer collectors is calculated assuming that all the flats in the blocks are connected, i.e. only single, separate houses are not connected (if any). Information about the number of connected single/detached houses in 2018 was provided by the WSS Operator, based on signed individual contracts for provision of wastewater service with the owners of the houses (or based on number of single house connecting sewer pipes). Equation 9 and Equation 10 (see details in **Chapter 3**) are used, i.e.

$$TNDW_{aggC1} = NDW_{cond} + NFH_{aggC1} \qquad (9)$$

$$TNDW_{aggC1} * PR_{DW,2018} = PR_{aggC1} \qquad (10)$$

The total number of residential dwellings (both flats and single houses), as well as the total number of single/detached houses at settlement level is calculated in a similar way as the usual resident population in 2018, i.e. based on the data from census 2011 and the information for 2018 at ATU level, received by NSI.

The calculations are given in

Table 19 and Table 20. Example:

- calculation of total dwellings in Brasov settlement in 2018:

$$115\,573/116\,124 * 126\,901 = \mathbf{126\,299}\ nr$$

- calculation of total single houses in Brasov settlement in 2018:

$$(20\,631)/(115\,573) \ * 126\,299 = \mathbf{22\,546}\ \boldsymbol{nr}$$

Table 19: Calculation of total number of dwellings and the total number of houses at settlement level in 2018

Brasov agglomeration settlements	Total dwellings at ATU level in 2011	Total dwellings at settlement level in 2011	Total single houses at settlement level in 2011	Total dwellings at ATU level in 2018	Total dwellings in settlement in 2018	Total single houses in settlement level in 2018
	1	2	3	4	5	6
BRASOV	116,124	115,573	20,631	126,901	**126,299**	**22,546**
GHIMBAV	2,038	2,038	1,020	2,754	**2,754**	**1,378**
SACELE	11,078	11,078	6,928	11,257	**11,257**	**7,040**
SANPETRU	1,822	1,822	1,777	2,249	**2,249**	**2,193**

Source for column 1,2,3 and 4: NSI

Table 20: Calculation of usual resident population connected to collecting system and the respective connection rate in 2018

Brasov agglomeration settlements	Single houses connected to CS	Total dwellings in settlement in 2018	Total houses in settlement in 2018	Usual resident population in the settlement	Connection rate to CS for each settlement,%	Residents connected to CS
	1	2	3	4	5	6
BRASOV	16 450	126 299	22 546	248 176	**95.17**	**236 197**
GHIMBAV	1 058	2 754	1 378	*4 612*	**88.4**	**4 076**
SACELE	2 191	11 257	7 040	*30 233*	**56.9**	**17 209**
SANPETRU	1 706	2 249	2 193	*5 112*	**78.3**	**4 004**

Source for column 1: WSS Operator APA Brasov

Source for columns 2, 3: Table 18, columns 5 and 6;

Source for column 4: Table 15, column 4

Example:

- calculation of connection rate in Brasov settlement in 2018:

$$\frac{126\,299 - 22546 + 16450}{126\,299} * 100 = 95.2\%$$

- calculation of number of connected people in BRASOV settlement in 2018:

$$248176 * 95.17\% = 236\,197$$

Similar calculations are made concerning the connection rate to UWWTP. In the case for Brasov agglomeration, the number of residents connecting to sewer collectors is the same as the number of people connected to UWWTP (i.e. there is no discharged of untreated sewer water into the river bodies).

1.3 Generated load of the agglomeration addressed by IAS

As mentioned in the methodology, it is considered that the load not currently connected to collecting system (and UWWTP) is generated by usual residents, living in these zones. Equations 13 and 14 are used:

$$PR_{agg\,2018} - PR_{aggC1} = PRaggIAS \quad (17)$$

$$L_{aggIAS} = PR_{aggIAS} \quad (18)$$

Table 21: Calculation of usual resident population addressed by IAS

Brasov agglomeration settlements	Usual resident population within agg. boundaries	Usual res. population connected to CS	Usual res. population addressed by IAS
	1	2	3
BRASOV	247,348	236,197	11,151
GHIMBAV	4,612	4,076	536
SACELE	29,477	17,209	12,268
SANPETRU	4,005	4,004	1
TOTAL			**23,956**

Source for column 1: Table 17, column 5

Source for columns 2, 3: Table 20, column 6

1.4 Generated load of the BRASOV agglomeration

Based on the above calculations, the generated load of the BRASOV agglomeration is:

242 780 + 23 956 = 266 736 p.e.

CALCULATION OF THE AGGLOMERATION LOAD FOR CODLEA AGGLOMERATION

1.1 Calculation of the usual resident population, as per 2018, in the settlements belonging to the Codlea agglomeration

Based on the newly delineated boundaries, Codlea agglomeration includes only Codlea settlement. The usual resident population is determined according to Equation 3 (see details in **Chapter 3**). The results are in **Table 22.**

$$PR_{S,2018} = \frac{PR_{U/R,2018}}{PR\ U/R,2011}\ x\ PR_{S,2011} \qquad (3)$$

Table 22: Calculation of usual resident population in 2018 for the settlements included in Brasov agglomeration

Settlement	Total population ATU urban area, 2011 $PRU_{/R,2011}$	Total population ATU urban area, 2018 $PRU_{/R,2018}$	Total population in the settlement, 2011 $PRS_{,2011}$	Total population in the settlement,2018 $PRS_{,2018}$
	1	*2*	*3*	*4*
Codlea	*397,026*	*389,743*	*21,708*	***21,310***

Source for columns 1, 2 and 3: NSI data base

The usual resident population within the agglomeration is determined according to Equation 4 (see details in **Chapter 3**) and using information from the maps, about some houses in the outskirts which are not included within the boundaries delineation. The average number of residents per dwelling is calculated based on information by NSI, at county level, about the total number of dwellings in urban and rural areas (

Table 23).

$$PRAGG,2018= (PRS1,2018-PREX,S1,2018)+(PRS2,2018-PREX,S2,2018)...+(PRSn,2018-PREX,SN,2018) + PR_{IN,Sn+1,2018} \qquad (4)$$

Table 23: Calculation of average number of residents per dwelling

Brasov county	Total usual res. population	Total number of dwellings, 2018	residents per house
	1	2	3
Total County	551183	252473	2.18
Total urban area	**389743**	**189116**	**2.06**
Total rural area	161440	63357	2.55

Source for columns 1, 2: NSI

The calculations are given in **Table 24.** The total number of usual resident population within the agglomeration is **21,186.**

Table 24: Calculation of usual resident population within the agglomeration boundaries

Settlements	*$PRS_{,2018}$*	*Average residents per dwelling*	*Excluded houses*	*Excluded population*	*Population within agg.boundaries*
	1	*2*	3	4	5
CODLEA	*21,310*	2.06	60	124	21.186

Source for column 1: Table 22, column 4
Source for column 2: Table 23, column 3
Source for column 3: information from the agglomeration map

1.2 Calculation of the load collected by the sewer system (LaggC1)

In the case of CODLEA agglomeration, all the generated load collected through the collecting system, enters WWTP Feldioara, i.e. Equation 6 (see details in **Chapter 3**).

$$L_{aggC1} = L_{aucEnteringUWWTP} \qquad (6)$$

There is an existing UWWTP (i.e. WWTP Feldioara), which however has no sufficient inlet monitoring data, allowing calculation of the average maximum weekly load, se per requirement of Art. 4(4) of the UWWTD.

Therefore the generated load, connected to the sewer collecting system/UWWTP Feldioara, shall be collected as though there is no UWWTP, i.e. based on specific pollution rates for the different groups of emitters.

In this case, the generated load collected by the sewer system will be calculated by using Equation 7 (see details in **Chapter 3**):

$$L_{aggC1} = L_{aggC1,PR} + L_{aggC1,NonPR} + L_{aggC1,IND} \qquad (7)$$

<u>*Load of usual resident population connected to the collecting system*</u>

The connection rate of the population of each settlement to the sewer collectors is calculated assuming that all the flats in the blocks are connected, i.e. only single, separate houses are not connected (if any). Information about the number of connected single/detached houses in 2018 was provided by the WSS Operator, based on signed individual contracts for provision of wastewater service with the owners of the houses (or based on number of single house connecting sewer pipes). Equation 9 and Equation 10 (see details in **Chapter 3**) are used, i.e.

$$TNDW_{aggC1} = NDW_{cond} + NFH_{aggC1} \qquad (9)$$

$$TNDW_{aggC1} * PR_{DW,2018} = PR_{aggC1} \qquad (10)$$

The total number of residential dwellings (both flats and single houses), as well as the total number of single/detached houses at settlement level is calculated in a similar way as the usual resident population in 2018, i.e. based on the data from census 2011 and the information for 2018 at ATU level, provided by NSI

The calculations are given in Table 25 and **Table 26.** In the case of Codlea, the ATU of Codlea, consists only of the settlement of Codlea.

Table 25: Calculation of total number of dwellings and the total number of houses at settlement level in 2018

Codlea agglomeration settlements	Total dwellings at ATU level in 2011	Total dwellings in settlement, 2011	Total single houses at settlement level in 2011	Total dwellings at ATU level in 2018	Total dwellings in settlement in 2018	Total single houses in settlement level in 2018
	1	2	3	4	5	6
CODLEA	8,054	8,054	3,316	8,236	**8,236**	**3,391**

Source for column 1,2, 3 and 4: NSI

Table 26: Calculation of usual resident population connected to collecting system and the respective connection rate in 2018

Codlea agglomeration settlements	Single houses connected to CS	Total dwellings in settlement in 2018	Total houses in settlement in 2018	Usual resident population in the settlement	Connection rate to CS for each settlement,%	Residents connected to CS
	1	2	3	4	5	6
Codlea	2,685	8,236	3,391	21,310	**91.42**	**19,482**

Source for column 1: WSS Operator APA Brasov
Source for columns 2, 3: Table 25, columns 5 and 6;
Source for column 4: Table 22, column 4

Example:

- calculation of connection rate in Codlea settlement in 2018:

$$\frac{8236-3391+2685}{8236} * 100 = 91.42\%$$

- calculation of number of connected people in Codlea settlement in 2018:

$$21310 * 91.42\% = 19\,482$$

Similar calculations are made concerning the connection rate to the UWWTP. In the case for Codlea agglomeration, the number of residents connecting to sewer collectors is the same as the number of people connected to the UWWTP (i.e. there is no discharged of untreated sewer water into the river bodies).

Load of non-permanent residents connected to the collecting system

Codlea is not a settlement with intensive tourist activities. According to the NSI data base for 2018, the maximum number of tourists was in April and it was 926 people for the whole month. Thus the average daily number of tourists, i.e 31 is negligible.

Based on this analyses the load of non-permanent residents for Codlea agglomeration **is 0 p.e.**

Load of industrial emitters connected to the collecting system

No information was provided by the WSS Operator concerning the industrial loads within the settlement. It is known however that all the industrial emitters are connected to the sewer network. In case of lack of "specific case" information and following the precautionary principle (i.e. not to underestimate the loads), it is assumed that the industrial load is 20 percent of the generated load of the population within the agglomeration, i.e.:

21 186*0.20 = **4 237 p.e**. industrial contribution

Thus the generated load within Codlea agglomeration, connected to the collecting system is a sum of the respective loads of the connected resident population and the industrial emitters:

19 482 + 4 237 = 23 719 p.e.

1.3 Generated load of the agglomeration addressed by IAS

As mentioned in the methodology, it is considered that the load not currently connected to collecting system (and UWWTP) is generated by usual residents, living in these zones. Equations 13 and 14 (see details in **Chapter 3**) are used:

$$PR_{agg\,2018} - PR_{aggC1} = PRaggIAS \quad (13)$$

$$L_{aggIAS} = PR_{aggIAS} \quad (14)$$

Table 27: Calculation of usual resident population addressed by IAS

Brasov agglomeration settlements	Usual resident population within agg. boundaries	Usual res. population connected to CS	Usual res. population addressed by IAS
	1	2	3
CODLEA	21 186	19 482	1 704

Source for column 1: Table 10, column 5

Source for columns 2, 3: Table 12, column 6

1.4 Generated load of the CODLEA agglomeration

Based on the above calculations, the generated load of the Codlea agglomeration is:

23 719 + 1 704 = 25 423 p.e.

4.4 Planning/defining of IAS zones

43. Spatial planning is fundamental for development of any territory – city, municipality or county. In the Romanian Spatial Planning System there are three urban planning documents related to different local and sub-local scales. The *General Urban Plan (PUG)* covers the entire administrative territory of a city or commune. It regulates the land-use, functional zoning, traffic, infrastructure, protected areas, historical monuments, maximum built-up, playing a strong control role in the local spatial planning. The *Zonal Urban Plan (PUZ)* regulates land-use in the main functional zones of the city characterized by a high complexity degree or an accentuated urban dynamic – historic centre, industrial zones, recreational zones, residential zones etc. The Zonal Urban Plan ensures the correlation of integrated urban development programs in the area with the General Urban Plan. The *Detailed Urban Plan* has specific regulatory character for a single plot in relation to the neighbouring plots.

Thus, one option of defining the IAS zones can be with the preparation of the PUG, considering only settlements within the scope of UWWTD – but not above 5,000 p.e. (see **4.2 Applicability of IAS in Romania** for more details). However, this would require options analysis (collecting system versus IAS) which is not in the scope of the PUG. On the other hand, the process of establishing agglomerations (in the sense of UWWTD) logically includes defining of low-density populated zones, where IAS are economically a better solution. However, the final decision on the IAS zones could be done at feasibility stage, considering environmental and other aspects (sensitive or less sensitive zone, drinking water protected areas, soil characteristics, discharge options into water body or soil etc.)

4.5 Registration and inspection of existing and new IAS

44. According to UWWTD Legal Compliance Assessment Methodology Document (June 20, 2014) *"Until now, the Commission has requested – in agreement with EU-MS – to provide information on the type of treatment provided in in-situ IAS and/or the rate of the generated load of an agglomeration transported to an UWWTP by truck after collection in IAS when the size of the agglomeration is more than 100,000 p.e. and the amount addressed by IAS is equal or more than 2% of the total load generated*", but

"*In the future the Commission may request further information on agglomerations for which a relevant percentage of the waste water is treated in IAS. The objective of such request would be to check if IAS is indeed "appropriate", as to ensure the level of environmental protection which is requested in Article 3"*

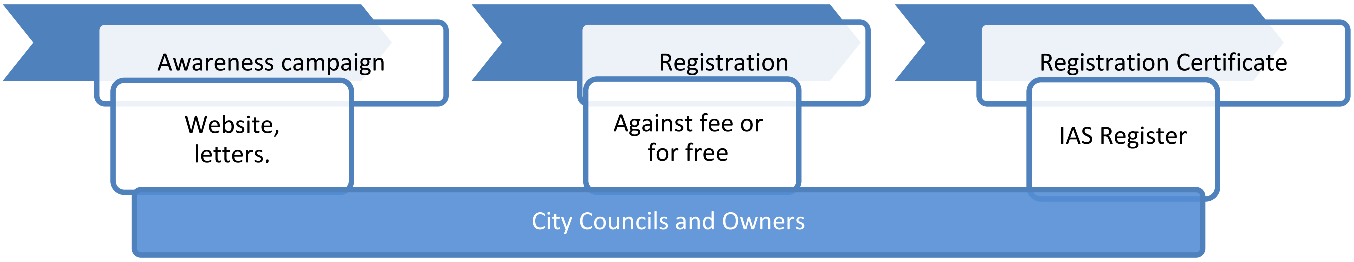
To be able to report the above to the Commission, the Romanian authorities will need detailed information of the IAS (especially the level of treatment) and has to establish a systematic approach for receiving and verifying information. Therefore, the following two-stage approach is proposed:

1) Registration of existing and new IAS;

2) Adequate inspection planning of existing IAS.

The two stages are discussed below and are shown on Figure 26 and Figure 27.

STAGE 1: REGISTRATION OF EXISTING AND NEW IAS



45. The approach presented in summary aims to collect information about the status of IAS in order to enable control over existing systems and plan the replacement/rehabilitation of those, which do not comply to the European and national requirements.

Figure 26: Proposal for registration of existing IAS

Source: WB elaboration for this report

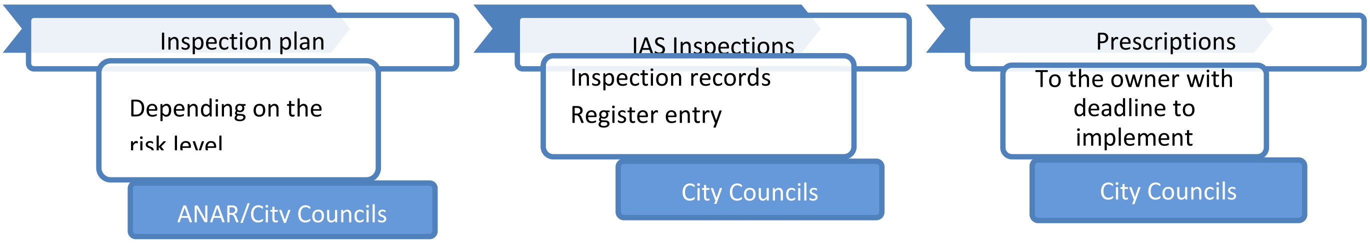
Adequate appraisal of the status requires IAS registry to clarify the type, location, number of users served, etc. An extensive awareness campaign is proposed to inform the citizens why registration is required, what follows registration, what the benefits to the society are, and the potential harmful impacts on human health and the environment from unauthorized IAS. The registration of existing IAS is suggested to be carried out within a certain period (e. i. 1 year or whatever is considered appropriate) and make it against small registration fee of 50 lei or for free. The latter is subject to governmental decision based on consultation with all counterparts, MoF included.

New IAS should be registered with the issuance of the permit to use for the newly built houses. It is proposed that the *city councils* carry out the registration, as they are best aware of the local conditions, they have knowledge about the owners and properties, new construction, including the type of IAS as approved in the construction permits. Based on the application filed by the owner, *city councils* would issue registration certificates and record IAS in a register, proposed to be established and maintained at each City Council. The city councils shall send monthly reports with IAS entries to the respective county council or IDA and the latter will enter them into a register established at county level. The county councils will send quarterly IAS reports to the respective River Basin Administrations (RBA) for their registers.

STAGE 2: ADEQUATE INSPECTION PLANNING OF EXISTING IAS

46. Due to the anticipated large number of existing IAS and different level of risk they pose on the human health and environment, annual inspection plans need to be elaborated first, based on the assessment of risk. Given the competences and information to carry this out, it is proposed that ***National Administration "Romanian Waters" (ANAR)*** together with the respective city council be made responsible. This will also help fulfil the requirement of the Framework Water Directive to categorize the pollution sources. When assessing the risks and planning the inspections, the following must be factored:

- River Basin Management Plans stipulations regarding status of surface and groundwater bodies, FRMP stipulations, the established Sanitary Protection Zones, sensitive areas etc.
- Agglomerations with built collecting systems, WSS master plans, regional FS, etc.



The plans should not include inspection of IAS in areas with built collecting systems since connection to the latter is mandatory. However, there seems to be significant challenges in implementing this legal requirement. Either national and/or county support schemes and secondary legislation needs to be developed.

Figure 27: Proposal regarding the planning of the replacement/rehabilitation of existing IAS

Source: WB elaboration for this report

The next step is to check the collected primary information from IAS registration, which would be carried out by field inspections. It is proposed that such inspections be carried out by the local or county authorities (public utilities services) staff because:

- they know the local situation best and the conditions in the construction permits;
- have qualified staff.

Each inspection will be recorded in a protocol and co-signed by owner and inspector, which would contain information about IAS type and its compliance/non-compliance with the legal/environmental requirements. The data from and copy of the record would be entered by the inspector into the IAS register.

Based on the records from the performed inspections, the *city councils* will give prescriptions to the owners, whose IAS do not comply with the legal/environmental requirements, in terms of the need for replacement/rehabilitation, and will give a deadline to implement. The prescriptions will serve to the owners as a basis for design-build/rehabilitation of the existing IAS. The implementation of the issued prescriptions is proposed to be supervised by the *State Inspection in Constructions.*

4.6 Design-Build of IAS

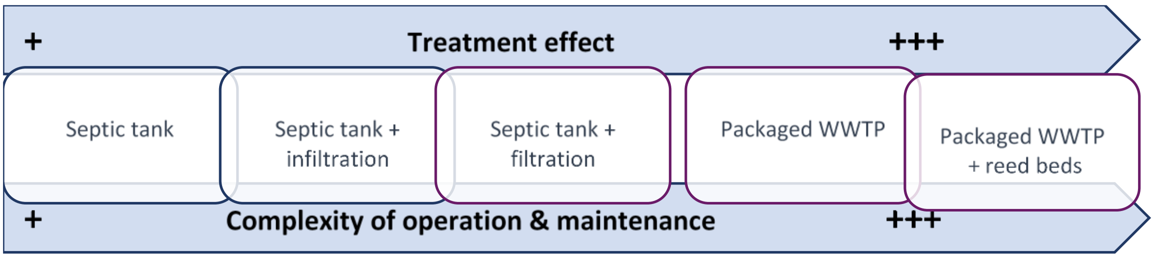
47. As mentioned above the Romanian water and wastewater legislation does not provide systematic regulation for design, construction and maintenance of IAS. Therefore, it is proposed that the requirements for IAS standards, already adopted by the Romanian Standards Association (ASRO) and CEN/TR 12566-2:2005 – Part 2: Soil infiltration systems, and CEN/TR 12566-5:2010 – Part 5: Pre-treated effluent filtration systems to be incorporated in the national legislation. This could be done by amending/supplementing the Norm NP 133/2013 to include a specific section on IAS.

4.7 Operation and Maintenance (O&M) of IAS

48. Operation and maintenance of IAS are activities, which require knowledge of the system – what processes are carried out, what are the indicators for their proper course, what potential issues may emerge and last, but not least – the potential risk to human health and the environment resulting from an improperly operated and/or maintained system. IAS are facilities with long operational life and their proper O&M is very important for reaching the required treatment effect. In this context several major issues, as discussed below, need to be clarified.

The frequency and the scope of O&M operations vary from one IAS type to another. O&M could only be about regular visual monitoring but may also involve a series of procedures, some of which require specific competence. Usually, the degree of complexity of the operation and maintenance rises along with the treatment level.

Figure 28: Complexity of O&M operations for various IAS depending on the treatment level



Source: WB elaboration for this report

O&M of septic tanks with filtration or infiltration usually only comes down to removal of the generated sludge once every 1 or 2 years. When unusual phenomena occur (leakages, swamping), then the infiltration system or filtering medium need inspection.

O&M of packaged WWTP and/or tertiary treatment WWTP is more complicated and will include, apart from visual inspections, various inspection and maintenance operations for mechanical elements (pumps, compressors etc.), checking/cleaning of sensors, inspection of power supply. Sludge also needs to be removed at certain intervals. In the case of wetlands or reed beds, seasonal maintenance of the vegetation is required.

Next table provides Ireland EPA recommendations regarding the frequency and scope of IAS O&M operations, which may be introduced as good practices in Romania.

Table 8: Frequency and scope of IAS O&M - Ireland EPA recommendations

System type	Minimum frequency of inspection	Minimum frequency of maintenance	Minimum frequency of monitoring
Septic tank	Once every 12 months by the owner or a competent individual	Sludge removal once every 12 months	Not applicable
Secondary treatment system or	Once every 6 to 12 months by a competent individual/company as	Sludge removal once every 12 months by a	Once every 12-23 months or according to permit or

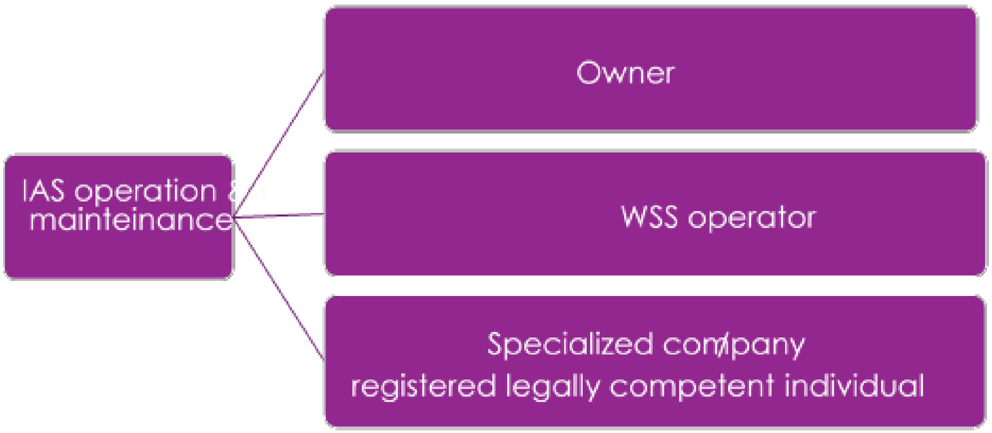
System type	Minimum frequency of inspection	Minimum frequency of maintenance	Minimum frequency of monitoring
packaged plant	recommended by manufacturer	competent individual/company.	according to manufacturer guidelines

Source: Irish EPA, 2009

Usually the responsibility for IAS O&M is with the owner since IAS are constructed within private property. Responsibility for the operation does not mean the owner must carry it out on its own.

Figure 29 presents several alternatives for individuals or legal entities, who could carry out the operation and maintenance.

Figure 29: Alternatives for O&M of IAS



Source: the WB elaboration for this report

OWNER

49. The owner has 24/7 access to IAS and may provide reliable information in terms of the wastewater discharge "regime". It may regularly perform observations if there is unusual odour, swamping of the infiltration field, accumulation of significant volume of sludge, etc.). Depending on its competence, it may take steps to address emerging issues. If the owner wishes to acquire knowledge in the operation and maintenance of its IAS and perform those activities on its own, it would be the least-cost option for the owner. However, the practice in most countries suggests that the owner usually neglects the need for O&M until a prominent issue emerges (such as, strong odour, swamping, overfilled tanks, etc.). The owner is often not aware that improper operation creates a risk to human health and the environment.

WATER OPERATOR

50. WSS operators have the competence required for that type of activities, possess specialized equipment and thus may provide adequate operation and maintenance of IAS. In this approach the risks to human health and the environment resulting from improper operation of IAS is minimal.

SPECIALIZED COMPANY

51. Presently, this is the option more widely applied for servicing the legally authorized IAS in Romania. The owner signs a contract with a firm to perform this type of activity. However, there is no institution to monitor that this actually is taking place and the wastewater/sludge is properly treated/utilized. Provided that this option is properly regulated, and control is ensured, there would be the following advantages:

- It ensures protection of human health and the environment because it is performed by competent persons;
- It ensures proper operation and maintenance of the facilities, which is a premise for their longevity;

Proper regulation includes:

- The need for a public register of the companies specialized in O&M of IAS;
- Introduction of criteria evidencing the specialized company's competence – such as, the company having O&M rights delegated by the manufacturing company for a specific IAS or certain individuals in the company holding technical competence certificate,

The Romanian authorities should make a decision what is the best way going forward, having in mind that significant number of IAS need to be upgraded or constructed. If an operator is to be in charge of the O&M of IAS there are options for distribution of these costs between the clients connected to the collection system and those using IAS. There is an option for allowing cross subsidization between users that will lead to more affordable prices for IAS users.

4.8 IAS monitoring and control

52. IAS monitoring may be carried out for two objectives:

- Check the facility's performance and decide on any change in the facility's mode of operation, etc.;
- Protection of human health and the environment.

The first objective has to do with IAS operation, therefore, it is not covered by this part of the report. To achieve the second objective, a decision must be made as to the type of monitoring, who will perform it and how often.

Regarding IAS, two monitoring options are presented:

1) Indirect monitoring – of the water body where treated wastewaters are discharged, either in a surface water body, or via diffusion through the soil into a groundwater body;
2) Direct monitoring at the outlet of each IAS (wastewater monitoring).

One type of monitoring is not exclusive of the other type of monitoring. But since monitoring is expensive, a reasonable decision must be made, which enables environment protection at the least cost.

With the indirect monitoring, IAS impact is easy to trace based on the existing monitoring practices, which ensure protection and improvement of the status of water bodies.

1) If outcomes from the analyses of regular samples taken from the water body indicate that the samples do not meet the standards, the respective RBA should evaluate whether the causes result from a random event, from a natural event, or from pollution.
2) If the survey reveals that there is a case of discharge or potential discharge of polluted wastewater, RBA needs to take additional samples and analysis of IAS in the area. The expenses associated with such additional sample-taking and water analysis should be borne by the owners of the IAS causing the pollution.

The direct monitoring is not a preferred option for IAS because:

- The pollution load from a single IAS is negligibly small to require regular observation;
- This would entail extra financial burden for both IAS owners and monitoring authorities.

Chapter 5. International experience on UWWTD implementation

53. The WB team reviewed the experience of a few EU Member States on UWWTD implementation and the relevant experience for Romania is shared below. Country reports presenting more details are included in **Annex 7: International experience on UWWTD implementation – country reports**. Although there is no doubt that the WSS sector is unique in each country due to historical reasons of service provision, institutional set up, size and capacity of WSS operators, sector regulation etc., and there is no "best solution", lessons can be learned. There are a few common challenges that the countries we have reviewed faced during the implementation of the UWWTD. The text below summarizes these challenges, so that Romanian authorities can learn from the international experience and utilize some of the good practices.

5.1 Reforming the WSS sector to accelerate UWWTD implementation and deliver results

54. In most (if not in all) of the countries reviewed (namely Cyprus, Greece, Hungary, France and Portugal) some form of WSS sector reforms or changes to allow for improved implementation of the UWWTD were witnessed.

One of the big changes in **Cyprus'** WSS sector has been the widespread recourse to Public-Private Partnerships (PPPs) following the Design-Build-Operate (DBO) model. The large WWTPs developed over the last three decades, as well as the smaller plants in rural areas, have been done under the DBO approach. The strategic decision to rely on DBO schemes for the development of WWTPs in Cyprus was concomitant to the other strategic decisions to develop extensive wastewater treatment reuse for agriculture as another nonconventional water resource to complement desalination. Adopting the PPP approach for the development and O&M of the WWTPs has allowed to transfer operational risks to private concessionaires, who are liable for financial penalties in case the treated effluents do not meet minimum standards, as it was considered that the technological complexity of tertiary wastewater treatment justified adopting the PPP approach. Operating WWTPs with tertiary treatment levels entails complex technological processes, with significant risks of noncompliance with the more stringent effluent standards[20] required for agriculture (and subsequent risks in terms of public health). Under DBO schemes the financing of the new plants was provided by the public developer and off-taker[21]. Still, the private sector remained responsible for the design, construction, and subsequent O&M of the plants. This helped the country to accelerate compliance with the UWWTD and achieve significant progress towards compliance.

55. With regard to the WSS sector **in Hungary**, one can find that there have been significant changes over the past years. After the Second World War, in the communist era, the water utility market was highly fragmented with more than 400 service providers, mostly owned by local councils. In the 1950's there was a reform aiming to halt the

[20] Cyprus adopted water quality standards for wastewater reuse in 2005. Standards for agriculture reuse are: BOD5 10 mg/l, suspended solids 10 mg/l, faecal coliforms (Escherichia coli) 5 per 100 ml, and no eggs of intestinal worms. This compares with BOD5 25 mg/l and SS 125 mg/l for effluent as required under the UWWTD standards.

[21] Either the urban sewerage boards, the Water development department, or for the new WWTPs in rural areas, the sewerage community boards.

fragmentation and introduce some form of rationalism by connecting the neighbouring water utility systems. The solution was to form state-owned service providers by merger of the smaller ones. In 1989, the Hungarian Parliament amended the Constitution and – among other things – the sanctity of private ownership was declared. On the one hand, it was a great achievement; but on the other hand, it started such dynamism of privatization that lasted until mid-1990's. The accelerator of this was the Act XXXIII (Law) of 1991 which stipulated that the assets of state-owned companies were transferred into the ownership of local governments. The former companies that were operating on a county level broke-down into several smaller service provider companies. The 38 service providers existing in 1989 turned into over 400 ones by 2010, predominantly owned by local governments operating along different economic and financial background and contractual framework.

After 2012 in accordance with the Act on Water Utility Services water supply and sanitation services can only be provided by having an operational license granted by the regulator. When the Parliament set up the regulator, one of its primary tasks was to conduct the licensing process during 2013-2014 and oversee the requests for license of the service providers in order to ensure the long-term sustainable, high quality and efficient operations. Those business associations in the form of limited liability company and private limited company could receive an operational license which possess an operational agreement for the supply area and complied with the criteria determined by law. According to these criteria a high level of technical capacity is vital to get a license, and in addition, financial indicators and the qualification of the staff and management are also fall under thorough examination.

Regarding the operational licensing process, one of the main instruments of aggregation is the introduction of the concept of 'consumer equivalent'. One consumer equivalent equal to one household's access to drinking water and/or to wastewater. The regulator issued the operational license for the service provider, if the consumer equivalent reached 50 000, and the service provider fulfilled the conditions of the law. In case, the total consumer equivalent a) didn't not reach 100 000, by 31 December 2014, b) reached 100 000, but it is less than 150 000, by 31 December 2016 the operational agreement should have been withdrawn. Due to mergers and termination of companies the total number of service provider companies in the country today is 40. As the result of aggregation, the number of service providers has been decreased and is to be continuously decreased, which generates a change of quality of supply, because the remaining service providers are going to operate along more transparent conditions. Bigger WSS companies had better capacity to implement WSS investments, which led to accelerated compliance with UWWTD.

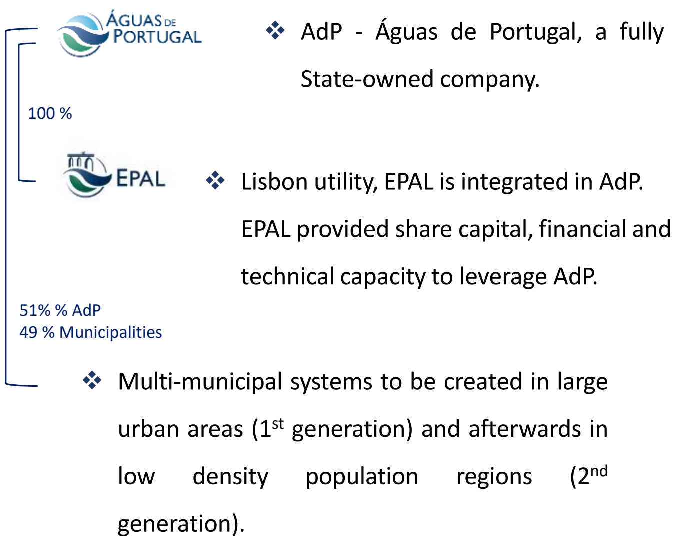
56. Following the approval of UWWTD in 1991, **France** published its first sanitation ministerial Decree and Order in 1994 and 1996 respectively. A national database was created in 2004. Between 2006 and 2012 the following actions were implemented to ensure the implementation of UWWTD:

- implementation of coercive and financial measures; inter-ministerial French circular published;
- Support of scientific institution IRSTEA to expertise some of the situations;
- Change in sanitation regulation. Publication of a new Ministerial Order;
- Recruitment of a senior project manager with high expertise in sanitation;

- The Minister of Ecology decided to put in place a national sanitation action plan (2007-2012) with a dashboard and the aim to become compliant before the end of 2012;
- Establishment of a strategy for answering to infringement procedures;
- Implementation of capacity building by national and local trainings;
- Creation of a scientific / technical / administrative working group to work on small treatment plant systems: EPNAC;
- Creation of the national sanitation website;
- The Minister of Ecology put in place a new sanitation action plan (2012-2018) with new indicators.

57. In **Portugal**, Agua de Portugal (a fully State-owned company) was established to participate together with municipalities in creation of multi-municipal companies. Bulk water supply and utility aggregation played a very important role in development of the sector and making it more attractive for investments, which also led to improved collection and treatment services.

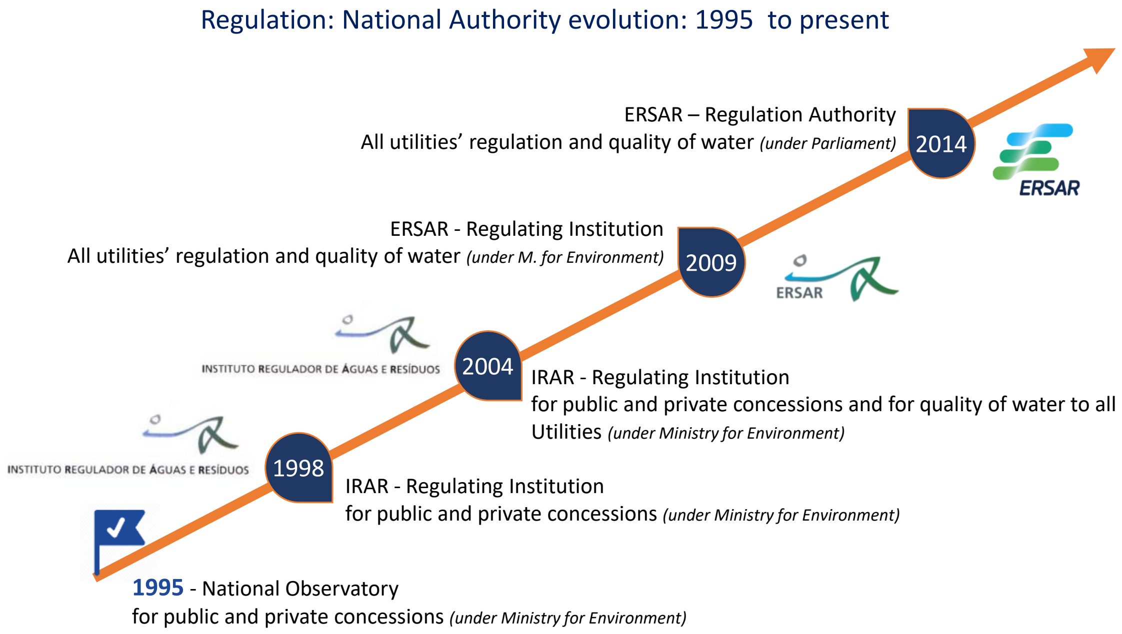
Figure 30: AdP structure



Source: AdP, 2018

A national economic regulator (ERSAR) was established as a regulation authority for drinking water supply, wastewater management and municipal waste management and the national authority for drinking water quality. The regulator ensures adequate protection for consumers and users of water supply and waste services by promoting service quality and guaranteeing socially acceptable pricing, by applying the following principles: essentiality, indispensability, universality, equity, reliability and cost efficiency. Since ERSAR makes sure that service provision is sustainable this enables public and private financing to flow more freely in the WSS sector.

Figure 31 Evolution of regulation in Portugal



Source: ERSAR, 2016

5.2 Agglomeration boundaries

58. With each National Implementation Program (NIP) **Cyprus** is updating agglomeration boundaries and recalculating pollution load. The first NIP-2005 presented the baseline for the creation of wastewater infrastructure. The program was based on administrative entities and boundaries with an inventory of 42 agglomerations and using the official population census of 2001, as published by the Statistics Department, estimated a total generated load of 675,000 p.e. arising from permanent, seasonal and tourist population in agglomerations greater than 2,000 p.e. The agglomerations were divided in respective categories based on their p.e. load as well as their discharge area (normal or sensitive area), details of which are shown in **Table 9** .

In the NIP-2005 the agglomerations were:

- 6 urban with a total of 545,000 p.e.
- 36 rural with total 130,000 p.e.

Table 9: Agglomerations based on the Size and Discharge Area in 2005[22]

Agglomeration Category	Normal Areas		Sensitive Areas		Total	
	no.	**p.e.[23]**	**no.**	**p.e.**	**no.**	**p.e.**
2,000-10,000 p.e.	31	102,900	4	16,100	35	119,000
10,000-15,000 p.e.	1	11,000	0	0	1	11,000
15,000-150,000 p.e.	2	137,000	3	218,000	5	355,000
More than 150,000 p.e.	1	190,000	0	0	1	190,000
Total	**35**	**440,900**	**7**	**234,100**	**42**	**675,000**
%	**83.3**	**65.3**	**16.7**	**34.7**	**100**	**100**

A reform of the inventory of the agglomerations was carried out in the revised NIP-2008 with a new methodology for calculating the size (generated load in p.e.) of the agglomerations, which was no longer based on past population data, but on future forecasted data. A safety factor was included in the size of the agglomerations to accommodate for possible future expansions of the agglomerations up to the end of their transitional period. The latest program is the NIP-2016, which includes 57 agglomerations with more than 2,000 p.e. and a total generated load of 1,029,000 p.e. The number of agglomerations with a population of more than 2,000 p.e. remained the same as in NIP-2008. However, the p.e. load is higher than that of NIP-2008 to take into consideration the extended transitional timeframe for compliance, which is 2027.

The 57 agglomerations comprise:

- 7 urban with a total of 770,000 p.e.
- 50 rural with total 259,000 p.e.

Table 10 presents the number of agglomerations and total generated load based on the category of agglomeration and the discharge area (normal and sensitive).

Table 10: Agglomerations per Size and Discharge Area for NIP-2016[24]

Agglomeration Category	Normal Areas		Sensitive Areas		Total	
	no.	**p.e.**	**no.**	**p.e.**	**no.**	**p.e.**
2,000-10,000	46	202,300	0	0	46	202,300
10,000-15,000	3	36,700	0	0	3	36,700
15,000-150,000	5	325,000	1	65,000	6	390,000

[22] MANRE (now MARDE). Implementation of the UWWTD in Cyprus. Situation at time of accession to the EC (1.5.2004), August 2007

[23] In Cyprus, one p.e. is 60 grams of BOD_5/day, and the concentration of BOD_5 is estimated at about 500 mg/liter.

[24] MARDE. Report on Article 16 of the UWWTD for 2015 and 2016, August 2018

More than 150,000	1	235,000	1	165,000	2	400,000
Total	**55**	**799,000**	**2**	**230,000**	**57**	**1,029,000**
%	**96**	**78**	**4**	**22**	**100**	**100**

59. The UWWTD sets obligations for the Member States, but according to **Hungarian** regulations, the implementation of these tasks is in the competency of local governments. Act LVII of 1995 on Water Resource Management declares that it is the public task of local governments to ensure urban waste water collection and treatment in the area of more than 2,000 p.e.[25] The Act on Water Resource Management stipulates that local governments fulfil this task in the framework of agglomerations set out by the government in a national program. This program is called the National Settlement Waste Water Discharge and Treatment Implementation Program. The government updates the Program every two years and revises the boarders of agglomerations if necessary. The law also describes the conditions for defining agglomerations for waste water collection and treatment. The following factors should be taken into consideration when defining agglomerations:

- environmental, public health and epidemiological,
- natural and landscape conservation
- geographical
- climatic, hydrological and hydrogeological,
- economic (settlement pattern, settlement development),
- technical,
- operational,
- social,
- touristic conditions.[26]

The methodology for defining agglomerations with more than 2 000 p.e. was first introduced in Hungary with the Governmental Decree 26/2002 (II.27.) on National Settlement Waste Water Discharge and Treatment Implementation Program and it was replaced by Governmental Decree 379/2015 (XII.8.) which came into force on 1 January 2016.

Table 11: Number of agglomerations and loads in Hungary

Agglomeration class	Number of agglomerations	Proportion of agglomerations	Total load of waste water (thousand p.e.)	Total rate of waste water load (%)

[25] Article 4 (1) b) of Act LVII of 1995 on Water Resource Management
[26] Article 7/A of Act LVII of 1995 on Water Resource Management

Under 2,000 p.e.	1173	67,7	696,9	5,6
2,000-10,000 p.e.	368	21,3	1654,2	13,2
10,000-15,000 p.e.	61	3,5	727,1	5,8
15,000-150,000 p.e.	115	6,6	4234,6	33,9
150,000 p.e. -	15	0,9	5183,5	41,5
Total	1732	100	12496,3	100

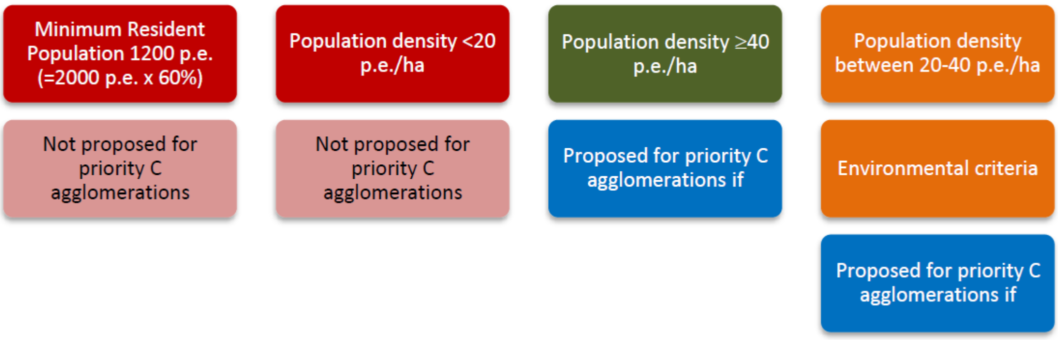
60. **Greece** also realized that one of the main challenges in applying UWWTD is to define sufficiently concentrated areas, where collection systems are most efficient solution. In 2018 a significant technical work was done, which proposed that sufficiently concentrated area can be associated with an assessment of population density and, consequently, for every area with estimated generated load greater than 2,000 p.e. the respective population density was calculated. The technical report used criterion of population density of 4,000 people/km^2 as a preliminary threshold in order to define sufficiently concentrated areas in agglomerations. For population densities lower than 2,000 people/km^2 implementation of individual or appropriate systems is proposed. When implementing the UWWTD, the ambiguous cases with population densities between 2,000 and 4,000 people/km^2 this need to be assessed on a case by case basis, considering also the local conditions, and consideration of additional environmental criteria.

    The implementation of the above-mentioned approach for identification of priority C agglomerations, can be summarized as follows: the first step is to determine the generated load of the communities which is followed by application of the cut-off criteria for definition of sufficiently concentrated area in the agglomeration. These criteria can then be combined with the wastewater services affordability and additional environmental criteria which are evaluated by considering sensitive areas and drinking water protected areas. **Figure 32** presents graphically these steps below.

Figure 32: Steps for identification of priority C agglomerations

ESTIMATION OF GENERATED LOAD

APPLICATION OF TECHNICO-ECONOMIC CRITERIA FOR IDENTIFYING SUFFICIENTLY CONCENTRATED AREAS, ADDRESSING WASTEWATER SERVICES AFFORDABILITY AND ENVIRONMENTAL CRITERIA



Source: Tools and methods for the identification of priority C agglomerations and cost estimates, EMVIS, 2018

Portugal did not do a specific work on establishing agglomeration boundaries in the past. However, during the preparation of WSS investments feasibility studies assess sufficiently concentrated areas to account for avoidance of excessive cost in achieving environmental benefits and compliance with UWWTD.

5.3 Individual Appropriate Systems

61. In **Cyprus** for the purposes of the Directive, the waste water addressed through IAS meets the treatment standards that are at least as high as those that apply to waste water delivered by a conventional collecting system. There are 3 agglomerations with IAS in place, serving a total generated load of 14,000 p.e. These are located in the agglomerations of:

- Pegeia (7,000 p.e.),
- Tala (4,000 p.e.) and
- Pissouri (3,000 p.e.).

In all of the above systems it has been ensured that the urban waste water is contained and separated from the surrounding environment. Two types of IAS are currently used in Cyprus. One of this is the grouping of dwellings which discharge their effluent into watertight tanks. The owners of the dwellings are responsible for the construction of their tanks which are inspected and approved prior to be put into use. The tanks when full are emptied by the owners using private tankers which transport the waste water to WWTP authorized to accept effluent from tankers. Records are kept by the WWTP receiving the waste water for monitoring purposes. Checks are carried out by the local authorities to ensure that all tankers discharge their effluent to designated WWTP and any Illegal dumping is reported to the Department of Environment.

62. In **Hungary** the introduction of data reporting was necessitated by the demand expressed by the European Commission in the EU-Pilot No. 6523/14 launched in 2014 because of the implementation of the Directive in Hungary and, as a follow-up to it, the infringement proceedings No. 2016/2186. Government Decree No. 379/2015. (XII. 8.) Korm. on the Municipality-Specific List of records on waste water disposal and treatment situation and the Information List, and on the delimitation of waste water disposal agglomerations (hereinafter: the "Government Decree") came into force as of 1 January 2016.

    Information on individual waste water treatment plants, individual septic tank facilities equipped with drainage fields, individual closed waste water storage reservoirs and investment data for the planned developments shall be collected in Hungary within the scope of data reporting in accordance with the Government Decree.

    The TSONLINE system was set up in 2017 by the General Directorate of Water Management in order to fulfil the mandatory reporting obligation under the Government Decree. The first go-live operation of the system took place in 2018.

    Pursuant to Section 4 of the Government Decree, data on waste water disposal and treatment:

    - individual sewage treatment plants,
    - septic tank facilities with drainage fields,
    - individual closed waste water storage reservoirs and the sludge arising from waste water treatment relative to all municipalities in Hungary shall be recorded in the Municipality-Specific List.

    Individual waste water treatment is the use of individual waste water treatment facilities for the treatment, final disposal and/or temporary collection and storage of urban waste water equivalent to a waste water load of at least 1 and at most 50-population equivalent.

63. In **Portugal** the use of individual appropriate systems (IAS) is widespread. ERSAR issued a quality assessment guide for water and waste services provided to users (3rd generation of the evaluation system). In its assessment the regulator is monitoring an indicator "number of dwellings located in the area of intervention of the management entity with individual solutions of wastewater (e.g. septic tanks) for which the sludge and wastewater removal service is provided by the managing body through its own mobile and or third-party means". The legislation requires that municipal wastewater services in urban areas cover the collection, drainage, elevation, treatment and rejection of urban wastewater, as well as the collection, transport and final destination of sludge from individual septic tanks. So, the service of cleaning of septic tanks constitutes a public service obligation and the management entities of the sanitation service ensure the cleaning of septic tanks to the properties located more than 20 meters from the public sanitation network (through own or third-party means). Because they are alternative services (in the user's perspective), ERSAR has been recommending that the tariff structure to be adopted for the cleaning of individual septic tanks is integrated into the general tariff.

5.4 Capital expenditures and financing

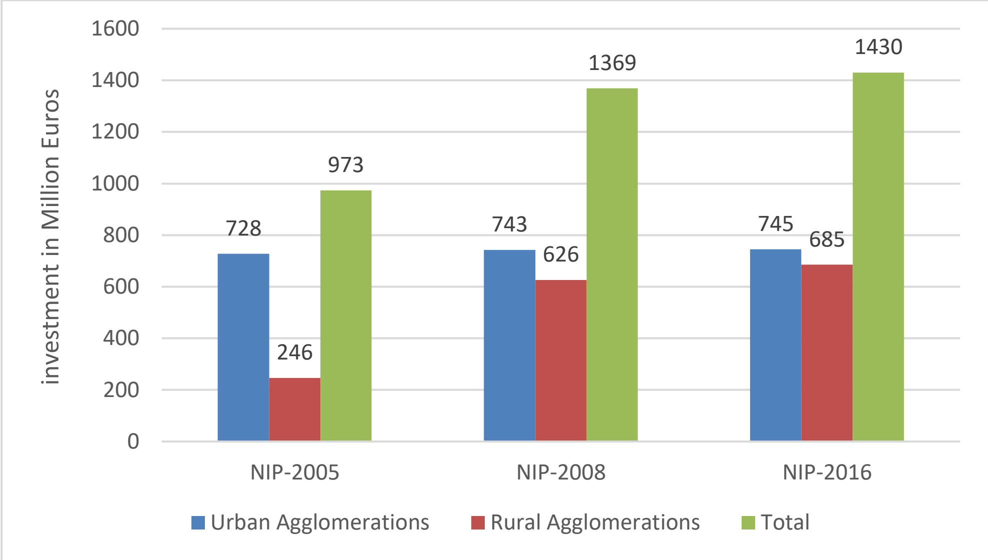
64. The financing and execution mechanisms for sewerage investments differ depending on the size of the agglomerations in **Cyprus**. In the urban agglomerations, the urban sewerage boards are financing, constructing, and operating the sewerage infrastructure. Financing for infrastructure investments is carried out through borrowing from the European Investment Bank (EIB) or commercial banks, to be repaid through the sewerage charges (both volumetric charges through the water bill, and the annual sewerage tax based on real estate value), with only the cost of tertiary wastewater treatment being subsidized by the central government. In the rural communities, the government is normally financing the construction with some grants from the EU cohesion funds which overall were less than 10 percent of the capital investments needed for the UWWTD.

Although sewerage investments largely came to a halt in 2013 with the Cyprus financial crisis and ensuing budgetary restrictions, most of the UWWTD objectives for the urban areas have been achieved. In the areas served by the five urban sewerage boards, the rate of coverage for sewerage collection services now stands at 84 percent—corresponding to a population of 645,000 being connected to sewerage networks. This represents a total length of about 2,800 km of sewer networks. It is estimated that an additional 270 km (less than 10 percent) would be needed to achieve full coverage based on targets set for compliance with the UWWTD.

Cyprus has proposed to the EC the updated UWWTD program (NIP-2016) with final compliance deadline set for 2027, taking into consideration inter alia the continuing budgetary constraints, and the special challenges of expanding sewerage systems in rural areas. This revised program aims to optimize the cost of UWWTD compliance, including consideration on individual appropriate systems (IAS) for rural areas where sewerage networks may not be the most economical solution. It is expected that for the complete implementation of the NIP-2016 by June 30, 2027, the additional amount to be spent will be approximately €747[27] million. The works that are planned between 2016 and 2027 relate to existing noncompliant agglomerations or agglomerations which have passed the deadline (2014). Projects include 25 collecting systems and 7 urban waste water treatment plants, with about 70% of this investment allocated to collecting systems. A graphical comparison of the total investments (past and forecasted) for compliance with Directive based on the respective NIPs is presented in **Figure 33**.

[27] 9th Technical assessment on UWWTD implementation – Annex V: National chapters, Final version May 2017

Figure 33: Total Investments (Past and Forecasted) for compliance based on respective NIPs



Source: NIP-2016

The EU Cohesion Funds will be used to secure part of the above investment amounting to €61 million, which is 8% of the total investments required. A comparison between the current situation of investments in collecting systems and treatment plants (new and renewed) and the expected situation between 2016 and 2027 shows that investments are expected to increase hugely and to reach an average of €62.6 million per year, representing € 73.8 per inhabitant per year[28].

65. Wastewater service coverage and infrastructure were lagging behind in development terms in **Hungary** despite several funding options of the central government in the early 1990's. Recognizing this drawback, an intensive support system was developed in 1993 using a designated and target support system. The first investment programs lasted until 2000 and a large amount of waste water systems were constructed and set into operation. The number of supplied settlements doubled from 14 percent in 1990 to 27,2 percent by 2000, with 70 percent of the total of their households connected to the waste water collection system. Investment programs between 2002-2006: the local governments had several options for financing their waste water investments. Until 2004 the most commonly used forms were the designated and target support systems for priority projects where in most cases the government's financial support was 50-75 percent of investment costs. The second most important investment program was the Environmental Fund which was later replaced by the Environmental and Water Target. Typically, the government financed 70-75 percent of investment projects and local governments had to bear the remaining costs. There were some cases, especially in disadvantaged regions where the government support even reached 100 percent. The third type of financial supports was the regional development support for disadvantaged areas.

Investment projects funded or co-funded by the EU (2002-2017): in Hungary, the ISPA and Cohesion Fund financing was supplemented by government support as well, so the local

[28] Source: Section 5.9, 9th Technical assessment on UWWTD implementation, Annex V: National chapters, Final version, May 2017

governments needed to bear only 10 percent of investment costs. There was only one exception: the Budapest Central Wastewater Treatment Plant and related facilities project, where the capital city's government bore 15 percent of the investment costs. The second financing solution was that the EU and Hungarian government co-financed projects utilizing the European Regional Development Fund by creating the so called Environmental and Infrastructural Operative Program (2002-2006). In these cases, the own contribution of local governments was only 5 percent.

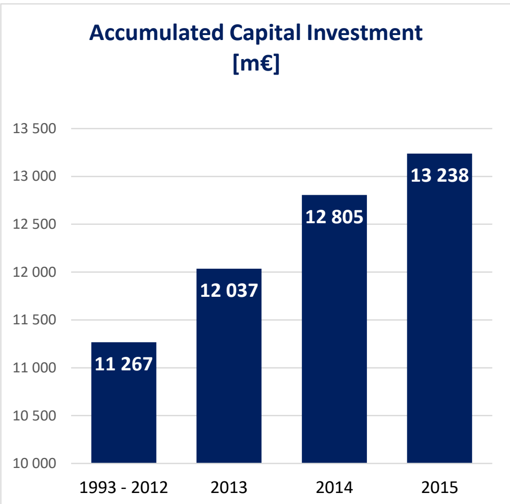
	2009	2010	2011	2012	2013	2014	2015
Actual payments for waste water projects (million EUR)	1,04	15,9	77,9	160	331,8	433,5	384,3

The above-mentioned program was replaced by the Environment and Energy Operative Program (2007-2013) where Hungary provided for 15 percent government co-financing from which almost half concerned waste water investments. The average of the own contribution of local governments was 16,5 percent.

	2015	2016	2017
Actual payments for waste water projects (million EUR)	0,57	43,8	296,5

This program was also replaced in the next EU budgetary period (2014-2020) by the Environment and Energy Efficiency Operative Program with a similar approach.

66. In **Portugal** between 1993 and 2015, 13,2 billion euros were invested, at an average of € 600 million per year.



CAPITAL INVESTMENT (Million €)	
WATER	7 124
Multi-municipal	3 760
Municipal	3 364
SANITATION	6 114
Multi-municipal	2 848
Municipal	3 266
TOTAL	13 238

Unit: Million €
Sources: ERSAR; GAG do PENSAAR 2020, AdP

Investment was distributed 50-50 for multi-municipal "bulk" systems and municipal "retail" systems. For water supply, € 7 124 million was invested, while the other € 6 114 million was applied in sanitation. To finance such investment, several sources were used, blending the "3 Ts" approach (Tariffs, Taxes and Transfers) and "blended finance".

European Cohesion Funds were decisive to “contain” tariff growth. Also decisive was the support from the European Investment Bank, mainly to AdP-Águas de Portugal.

32 concessions and 5 joint companies (with shared equity between municipalities: 51 percent, and private operators: 49 percent) were awarded to private operators by 48 municipalities.

Altogether, € 6 390 million were obtained in the form of EU “lost funds” (transfers); € 3 450 million came from loans and private equity and; the remaining € 3 390 million from tariffs and taxes.

Funding Sources

European Union grants	€ 6 390 Million
European Investment Bank	€ 1 900 Million
Bonds – Private Placement	€ 600 Million
PPPs	€ 950 Million
Tariffs and Taxes	€ 3 390 Million

Sources: ERSAR, AdP-Águas de Portugal; PENSAAR 2020

5.5 Compliance issues with the UWWTD

67. Since joining the EU in 2004, **Cyprus** made considerable efforts to comply with UWWTD. At that time, significant sanitation investment was still required to expand sewerage networks and wastewater treatment within the areas covered by the large urban agglomerations on the island. In addition, compliance with the UWWTD required Cyprus to make an unprecedented effort to provide sewerage services in rural areas, which were largely undeveloped, by developing sewerage infrastructure in a total of 50 agglomerations above 2,000 p.e. (only 6 already had sewerage systems) as well as several smaller villages.

Procedural, social (public acceptability), legal, organizational and administrative issues were factors which caused major delays in the commencement of the wastewater infrastructure construction. Nevertheless, the proper identification of agglomerations and correcting the original classification at a later stage, in the revised NIP-2008, created additional delays. The critical factor for the implementation of the wastewater infrastructure (collection systems and treatment plants) was and still is the lack of financial resources to cover the construction costs. The delay in complying with the directive triggered financial consequences; thus, the fines to be paid for infringement diverted significant financial resources from the investment program and induced additional implementation delay.

Delays in project tendering for the construction of wastewater infrastructure occurred because of the lengthy procurement procedures. Tendering, evaluation and contracting according to the EC procedures took much longer than originally planned or anticipated. Procedures such as publishing announcements, public presentations, receiving public opinions delayed the whole process of preparing final designs and execution plans. The need to secure public acceptance and agreement regarding the location of the treatment plants contributed to the implementation delays. Although the design for many treatment plants had been completed the most difficult task was the identification of a broadly acceptable location for them. Procedural and administrative matters took longer than anticipated such as discussions with municipalities and communities on connecting to existing systems and to avoid creating a treatment system per agglomeration or getting administrations to agree to merge, smaller urban centers to join larger urban centers.

68. For **Hungary** following the closure, on 7 December 2016, of the EU Pilot process that lasted two years, the Commission initiated infringement proceedings as it had considered that, on the basis of the information available, the requirements of the UWWTD were not met for 23 agglomerations in Hungary within the deadlines set in the Accession Treaty.

    Referring to the case law of the Court of Justice of the European Union, the Commission emphasized that if an agglomeration does not have systems to collect all urban waste water produced by the agglomeration concerned, the obligation under the Directive to ensure that all collected urban waste water undergoes secondary or equivalent treatment cannot be a priori considered to be met.

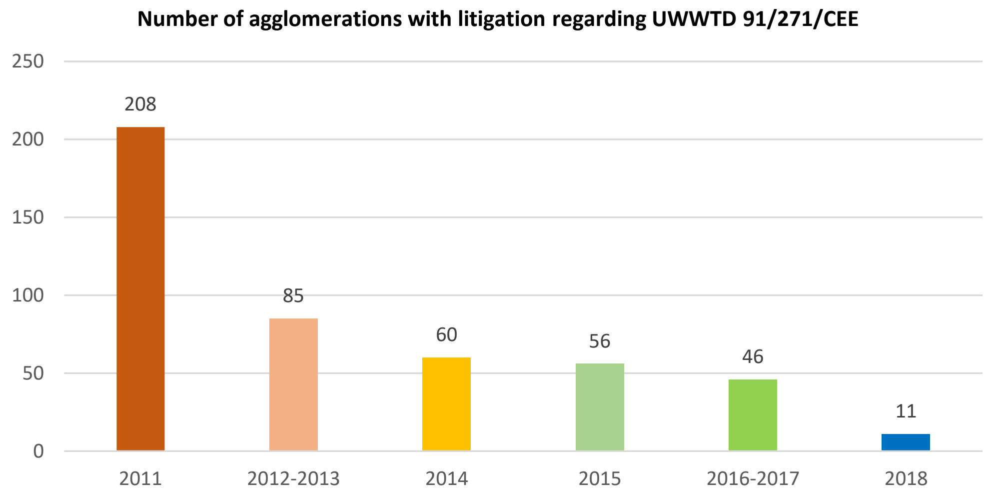
    Hungarian reply to the formal notice was sent to the Commission on 21 April 2017. In this reply Hungary has shown that indeed the concerned agglomerations with one exception do not comply with the Directive. The main problem with the implementation of the Directive is the low connection rate to the established collecting network. The following reasons of this were identified during 2016: unused plots, uninhabited real properties, financing problems of socially disadvantaged people, special technical conditions. Hungary is working to improve the connection rate to the sewer network as a result of cooperation with notaries, district offices and water utility providers.

    With regard to the objections raised by the Commission in its reasoned opinion, Hungary explained that the Ninth Report on the implementation status and the programs for implementation of the Council Directive 91/271/EEC concerning urban waste water treatment, which was published by the Commission on 14 December 2017 (hereinafter “the Commission report”), had shown that, according to the reference state of 31 December 2014, the rate of compliance with Article 3 of the Directive was 100%, the rate of compliance with Article 4 was 95%, and the rate of compliance with Article 5 was 92%. According to the report, compliance with Article 5 has improved. The report concludes that, overall, looking at the performance as a whole, the situation in Hungary has improved compared to the previous report.

69. Regarding non-compliance with the UWWTD, the reporting to the EC in 2018 - with data for the year 2016 - stated 16% of cases of non-compliance for **Portugal**. For these cases, measures were taken with an investment of around € 254 million for urban WWTP and € 10 million for urban wastewater collection and drainage networks. This investment was programmed for the period 2013 - 2022.

    Currently, Portugal has two infringement proceedings (in 11 agglomerations) for non-compliance with article 4 (secondary treatment) and article 5 (more advanced treatment in agglomerations with generated load above 10,000 p.e. and discharging in sensitive zones).

Figure 34: Number of agglomerations with litigation regarding UWWTD



Source: GAG PENSAAR 2020, 2018

As regards the 1st case concerning small agglomerations (<15,000 p.e.) for failure to comply with Article 4, out of the 44 agglomerations initially incorporated in that litigation, only 10 still don't meet all the requirements, of which 4 are in construction phase and the remaining are in the process of stabilizing the treatment process (WWTP testing phase). It is envisaged that by 2020 all agglomerations will fully comply with UWWTD requirements.

70. As for **France** the first sentence of the court of justice was in 2004. France was at risk to pay a fine of 400 million euros. A policy to comply with the UWWTD directive supported at the highest level of the Government by the Prime Minister and the Minister of Environment was put in place in 2006. Local representatives of the State were designated to be in charge of the implementation. Collaborative common coherent approach started to be implemented at local level between representatives of the government and the River Basin agencies. As a result, a new ministerial ordinance implemented requiring that:

- Letters of formal notice have to be taken by the Prefects (local representatives of the Government); start and end of works have to be written;
- Criminal and financial sanctions can be applied if local authorities don't respect the deadlines;
- Criminal sanctions can be applied if there's water pollution;
- Development of new buildings is forbidden until the agglomeration and UWWTP is compliant,
- River basin agencies have the authorization to give subsidies to local authorities to help them to build their sanitation system. Subsidies can be reduced if deadlines of the works are not respected;
- Prefects can be called by the prime minister's cabinet if they don't fail to apply the ordinance.

More information on infringement cases is presented in **Annex 7: International experience on UWWTD implementation – country reports**.

Annex 1: Data used for calculation of CAPEX for collecting networks (FS for LIOP financing)

Settlement	County	New connected people WW	Total length (WW pipes + collectors)	Total costs for construction (WW pipes, collectors, pumping stations) EUR
Stolnici	Arges	2 714	44 948	4 576 427
Poiana Lacului	Arges	4 937	76 031	8 345 292
Costești	Arges	3 385	44 550	6 697 110
Albota	Arges	2 782	28 999	3 666 649
Buzoești	Arges	3 834	35 756	4 285 157
Ștefănești	Arges	5 251	37 341	6 185 177
Bascov	Arges	3 937	14 838	2 310 404
Topoloveni	Arges	2 491	9 353	1 087 573
Moșoaia	Arges	2 132	5 987	672 436
Predeal	Brasov	834	18 264	4 520 385
Nehoiu	Buzau	525	22 025	3 347 744
Patarlagele	Buzau	1 464	42 352	7 700 104
Merei	Buzau	3 701	88 904	15 970 708
Topliceni	Buzau	1 927	33 986	6 310 345
Beceni	Buzau	3 678	42 791	7 694 869
Puiesti	Buzau	2 838	44 439	6 429 749
Pietroasele	Buzau	2 998	35 401	5 996 487
Cernatesti	Buzau	1 884	28 695	4 978 231
Sapoca	Buzau	2 949	38 465	5 836 437
Valea Ramnicului	Buzau	3 591	33 640	5 366 413
Vernesti	Buzau	3 068	28 694	4 805 379
Grebanu	Buzau	4 017	30 939	5 867 494
Siriu	Buzau	2 799	18 785	3 233 183
Cislau	Buzau	4 371	26 623	4 953 016
Jegalia	Calarasi	3 390	16 061	2 766 377
Mircea Voda	Constanta	1 945	29 229	4 422 235
Baneasa	Constanta	2 511	29 778	4 257 789
Pecineaga	Constanta	1 420	15 694	1 784 548
Ciobanu	Constanta	3 023	30 642	3 771 519
Mangalia	Constanta	1 140	11 037	1 547 914
Limanu	Constanta	2 514	23 067	5 573 847
23 August	Constanta	2 943	21 233	5 983 141
Valu lui Traian	Constanta	6 013	36 524	12 653 952
Eforie	Constanta	851	4 318	638 803
Techirghiol	Constanta	2 179	10 155	1 369 487
Castelu	Constanta	2 914	13 526	2 139 958
Cumpana	Constanta	1 554	6 703	1 271 059
Mihail Kogalniceanu	Constanta	4 305	18 457	2 020 052
Agigea	Constanta	2 998	10 316	1 695 064
Costinesti	Constanta	927	2 799	471 181
Corbu	Constanta	4 570	8 257	1 210 690
Navodari	Constanta	9 171	14 713	1 910 661
Constanta	Constanta	27 173	26 851	6 811 333
Tuzla	Constanta	2 190	1 966	392 245

Settlement	County	New connected people WW	Total length (WW pipes + collectors)	Total costs for construction (WW pipes, collectors, pumping stations) EUR
Crevedia	Dambovita	2 913	39 066	7 839 298
Ghercesti	Dolj	1 532	17 953	3 100 192
Mischii	Dolj	1 457	16 128	2 626 820
Maglavit	Dolj	4 408	40 874	5 849 300
Rastu Nou	Dolj	3 023	27 800	4 905 105
Ostroveni	Dolj	4 577	40 104	7 456 308
Carcea	Dolj	3 324	23 923	3 459 185
Poiana Mare - Piscu Vechi	Dolj	11 789	39 444	4 936 257
Breasta	Dolj	3 163	11 663	2 266 952
Calafat	Dolj	6 925	26 934	4 794 734
Simnicu de Sus	Dolj	4 380	25 665	3 635 193
Malu Mare	Dolj	3 180	18 244	3 815 034
Cerat	Dolj	3 821	21 028	3 416 896
Calarasi	Dolj	5 030	27 499	3 643 042
Craiova	Dolj	34 379	118 654	23 100 945
Bechet	Dolj	2 976	7 575	1 205 904
Dabuleni	Dolj	11 090	27 991	3 846 413
Bucovat	Dolj	3 811	9 524	2 152 135
Isalnita	Dolj	2 614	5 793	719 403
Brad	Hunedoara	13 266	7 990	1 906 500
Criscior	Hunedoara	3 522	9 905	2 528 625
Calan	Hunedoara	9 110	2 880	723 000
Certeju de Sus	Hunedoara	3 442	5 250	1 421 250
Dobra	Hunedoara	1 859	10 600	2 288 800
Geoagiu	Hunedoara	8 217	6 644	1 622 050
Hateg	Hunedoara	8 326	10 741	2 685 250
Hunedoara	Hunedoara	55 659	18 379	4 811 600
Simeria	Hunedoara	1 038	2 952	665 400
Teliucu Inferior	Hunedoara	2 070	4 500	810 000
Ghelari	Hunedoara	1 840	11 500	2 065 000
Ilia	Hunedoara	2 759	19 079	2 870 665
Hațeg	Hunedoara	2 062	9 485	2 986 950
Simeria	Hunedoara	10 615	18 330	3 004 150
Fierbinti	Ialomita	126	1 030	283 153
Cazanesti	Ialomita	2 932	22 840	4 282 355
Fetesti	Ialomita	5 813	23 346	3 746 054
Tandarei	Ialomita	3 853	9 912	1 703 474
Slatina	Olt	4 774	24 000	3 572 626
Caracal	Olt	9 857	18 260	5 327 731
Bals	Olt	1 506	4 530	2 816 369
Corabia	Olt	5 892	31 150	6 583 033
Draganesti-Olt	Olt	3 968	16 040	2 756 527
Scornicesti	Olt	2 084	20 750	3 656 738
Potcoava	Olt	2 833	11 560	2 507 297
Piatra-Olt – Ganeasa	Olt	4 132	25 760	5 152 667
Farcasele - Dobrosloveni	Olt	4 470	8 630	2 345 327
Gostavatu-Babiciu-Scarisoar	Olt	4 648	15 940	4 255 832
Balteni-Perieti-Schitu	Olt	3 535	13 340	3 589 355
Tia Mare	Olt	3 157	7 770	1 645 176
Rusanesti	Olt	2 554	8 840	1 670 666
Serbanesti-Crimpoia	Olt	4 870	37 290	6 150 748
Visina	Olt	1 252	15 530	1 702 515

Annex 2: Data used for calculation of CAPEX for small UWWTP (FS for LIOP financing)

N	Settlement	County	capacity (p.e.)	Cost EUR
1	Construcție SEAU Abrud	Alba	5 200	2 144 000
2	Abrud	Alba	5 200	1 642 000
3	Construcție SEAU Baia de Arieș	Alba	2 500	1 424 000
4	Baia de Aries	Alba	2 500	1 085 500
5	Albota	Arges	7 665	3 213 908
6	Cleja	Bacau	8 929	1 793 071
7	Garleni	Bacau	7 818	1 515 820
8	Faraoani	Bacau	6 056	1 519 245
9	Magiresti	Bacau	4 739	1 362 322
10	Gioseni	Bacau	4 677	1 296 202
11	Tamasi	Bacau	3 418	1 394 911
12	Cotofanesti	Bacau	3 379	1 487 311
13	Filipesti	Bacau	3 285	1 368 140
14	Stefan cel Mare	Bacau	2 663	1 538 631
15	Josenii Bargaului	Bistrita Nasaud	7 100	2 811 735
16	Puiesti	Buzau	3 327	2 269 213
17	Siriu	Buzau	3 080	2 225 088
18	Beceni	Buzau	2 430	2 146 467
19	Chiselet	Calarasi	5 743	1 170 855
20	Frumusani	Calarasi	3 446	1 265 950
21	Jegalia	Calarasi	3 000	2 173 821
22	Dorobantu	Calarasi	2 931	1 153 180
23	Negru Voda	Constanta	3 600	2 458 800
24	Baneasa	Constanta	2 800	2 259 600
25	Baneasa	Constanta	2 800	2 259 600
26	Dobra	Hunedoara	2 000	1 000 000
27	Ghelari	Hunedoara	2 000	840 000
28	Cazanesti	Ialomita	2 500	2 143 428
29	Ciolpani	Ilfov	7 460	2 049 454
30	Gradistea	Ilfov	5 335	1 953 616
31	Petrachioaia	Ilfov	4 050	1 971 758
32	Gostavatu-Babiciu-Scarisoara	Olt	7 496	1 614 547
33	Serbanesti-Crimpoia	Olt	6 087	2 621 370
34	Farcasele - Dobrosloveni	Olt	5 587	1 926 393
35	Balteni-Perieti-Schitu	Olt	5 439	1 508 402
36	Rusanesti	Olt	4 120	1 379 370
37	Tia Mare	Olt	4 047	1 656 001
38	Batarci	Satu Mare	5 262	2 297 730
39	Tarsolt	Satu Mare	5 051	2 270 049
40	Orasu Nou	Satu Mare	2 031	1 352 264
41	Islaz	Teleorman	3 977	1 788 756
42	Satchinez / Hodoni	Tlimis	5 054	1 324 750
43	Cenei	Tlimis	4 701	1 314 830
44	Chizatau	Tlimis	2 188	1 233 150
45	Gavojdia	Tlimis	2 120	1 128 570

Annex 3: Questionnaires to WSS operators

Detailed questionnaires to WSS operators on settlements they are serving and coverage with collection system, wastewater treatment, performance of WWTPs and etc. were prepared and through MEWF and ANRSC delivered to all service providers. The required database for the recalculation of agglomeration pollution loads was elaborated via use of the Microsoft Office, Excel application software.

(an electronic file and electronic tables in Microsoft Excel are attached to this report)

Annex 4: Examples on sufficient and insufficient WWTP inlet monitoring data

UWWTP BRASOV, BRASOV COUNTY

WWTP Brasov is an example for a treatment plant with sufficient inlet monitoring data, that allows calculation of maximum average weekly load within one year. This is in line with the requirements of Art. 4 (4) of the UWWTD. Monitoring data have been received by the WSS Operator for 2018. The data was processed as the summary results are represented below:

Figure 35: Inlet flow data at UWWTP Brasov

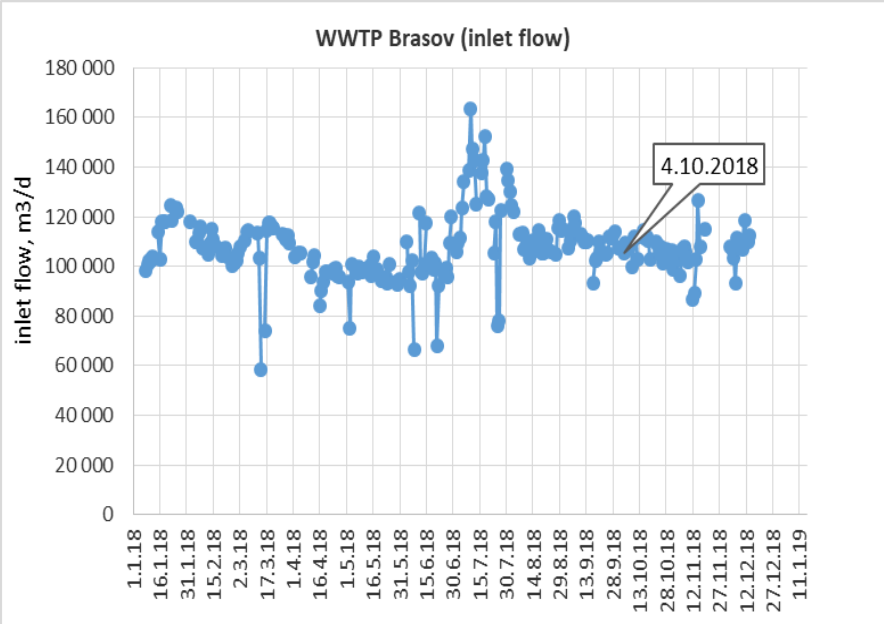


Figure 36: Inlet monitoring data for BOD5 concentrations at UWWTP Brasov

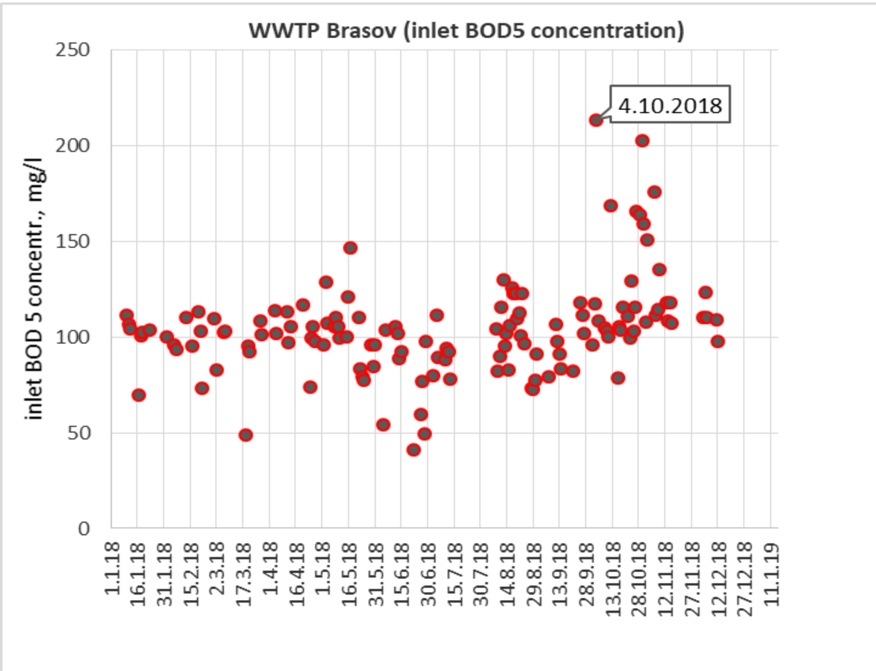
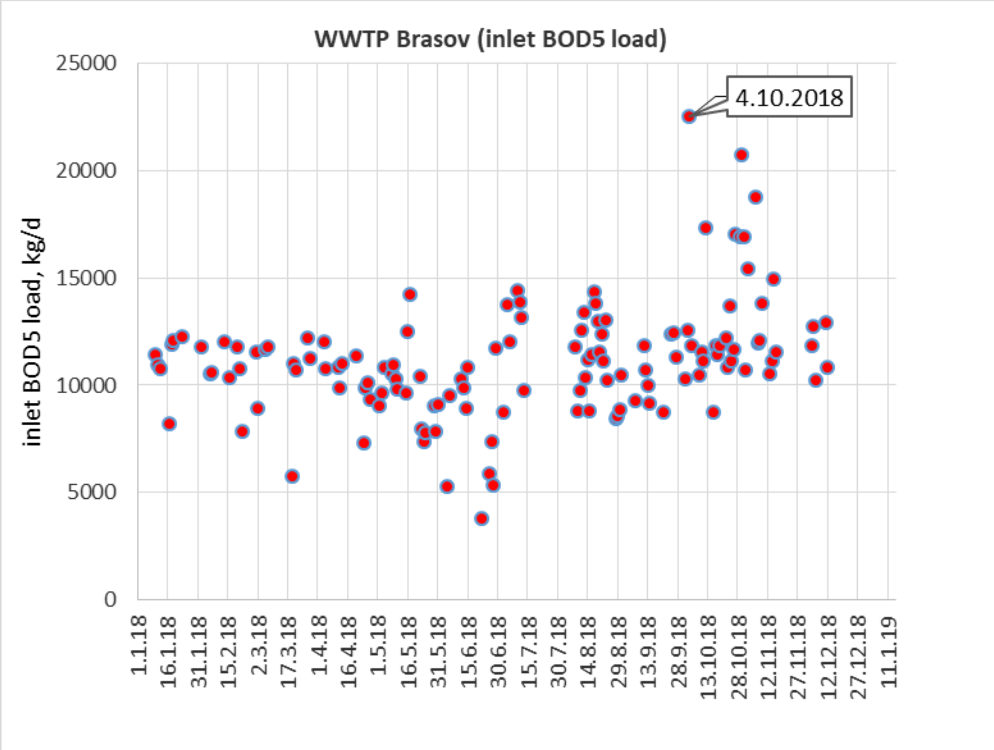


Figure 37: Results of calculate Inlet BOD5 load at UWWTP Brasov



Analyzing the data, with some small exceptions, there are smooth trends in the daily values for all the investigated parameters. It is obvious that there is an increase in BOD5 concentrations at the inlet, respectively in the BOD5 loads in the second half of October. The value on 4.10.2018 was excluded since it is exceptional in the period 1.10-6.10.2018, almost double than the other daily values in the week. The higher result may be due to an error either in the sampling or in the analytical measurements.

The values in the period 29.10 – 4.11. 2018 however were not excluded, although high, since there was no evidence in the inlet flow data that they are due to have rains. Furthermore, the values in all the week are high, which could be due to some excessive industrial pollution.

The available (i.e. meaningful values) information is summarized in the following table:

Table 12: Summary inlet monitoring results of UWWTP Gaesti

WWTP Brasov	Q	BOD5 max average weekly load
	m3/a	kg/d
Values	24 413 869	16 118
Nr samples	227	134

The maximum average weekly load of UWWTP Brasov, in p.e., is: 16 118/0.06 = **268 637 p.e.**

UWWTP Feldioara, BRASOV COUNTY

WWTP Feldioara is an example for a treatment plant with insufficient inlet monitoring data, which does not allow calculation of maximum average weekly load within one year (as per the requirements), although some monitoring data have been received by the WSS Operator for 2018. The data was processed, as the summary results are represented below:

Figure 38: Inlet flow data at UWWTP Feldioara

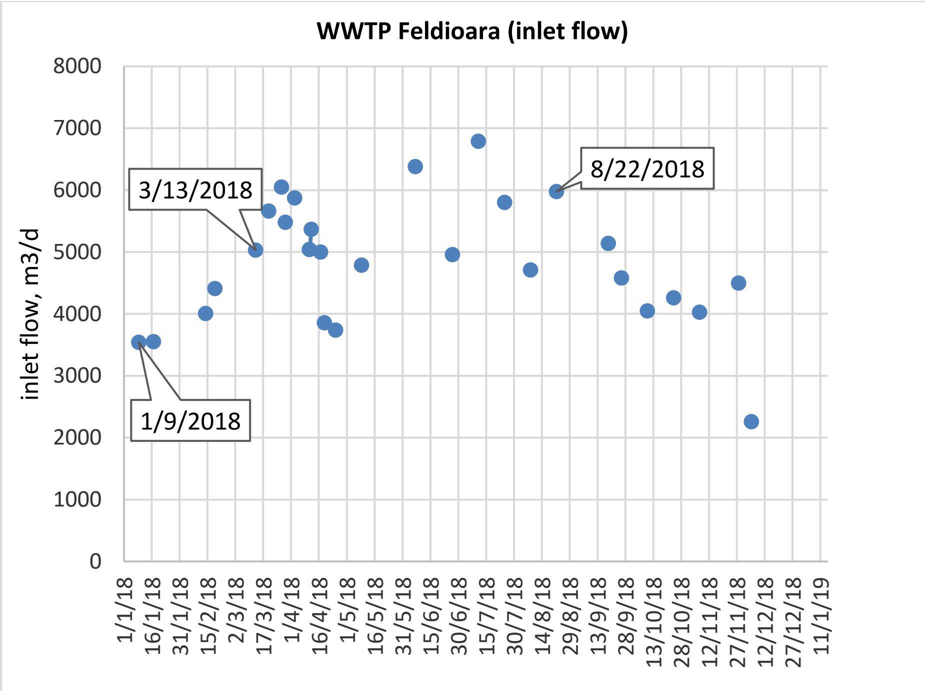
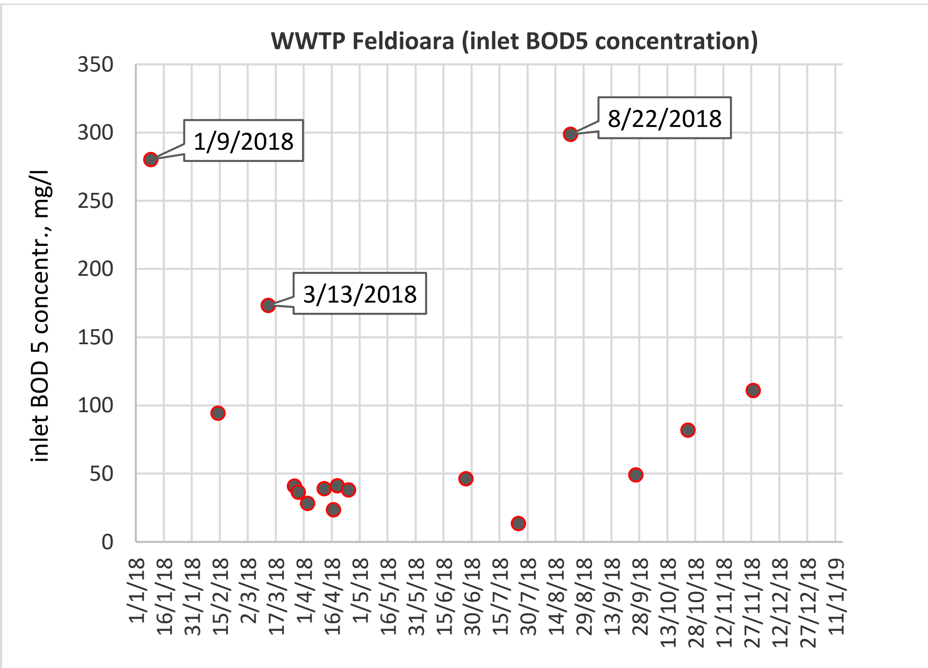


Figure 39: Inlet monitoring data for BOD5 concentrations at UWWTP Feldioara



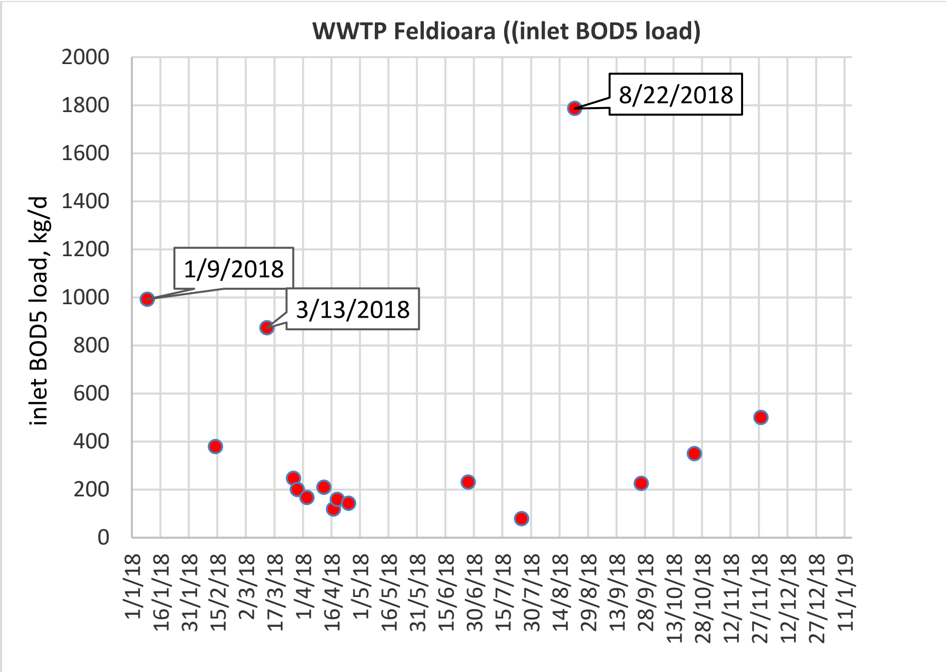


Figure 40: Results of calculate Inlet BOD5 load at UWWTP Feldioara

Analyzing the data, the inlet flow trend seems to be okay, although there is an evidence for seasonal irregularity, i.e. during the summer the flows seem to be higher. Analyzing the inlet BOD5 concentrations however, the values were very scattered with extremely high values on 9.01.2018, 12.3.2018 and 22.08.2018, which also reflect in extremely high BOD5 loads. There was no evidence that these values are due to extremely high rainfalls.

The available information is summarized in the following table:

Table 13: Summary inlet monitoring results of UWWTP Feldioara

WWTP Brasov	Q	BOD5 max average weekly load
	m3/a	kg/d
Values	1 757 944	1 191
Nr samples	28	16

The existing monitoring data base is too scarce to allow representative determination of the maximum average weekly inlet BOD5 load of UWWTP Feldioara.

UWWTP Insuratei, BRAILA COUNTY

WWTP Insuratei is an example for a treatment plant with sufficient inlet monitoring data, allowing allow calculation of maximum average weekly load within one year. Monitoring data have been received by the WSS Operator for 2018. The data are processed as the summary results are represented below:

Figure 41: Inlet flow data at UWWTP Insuratei

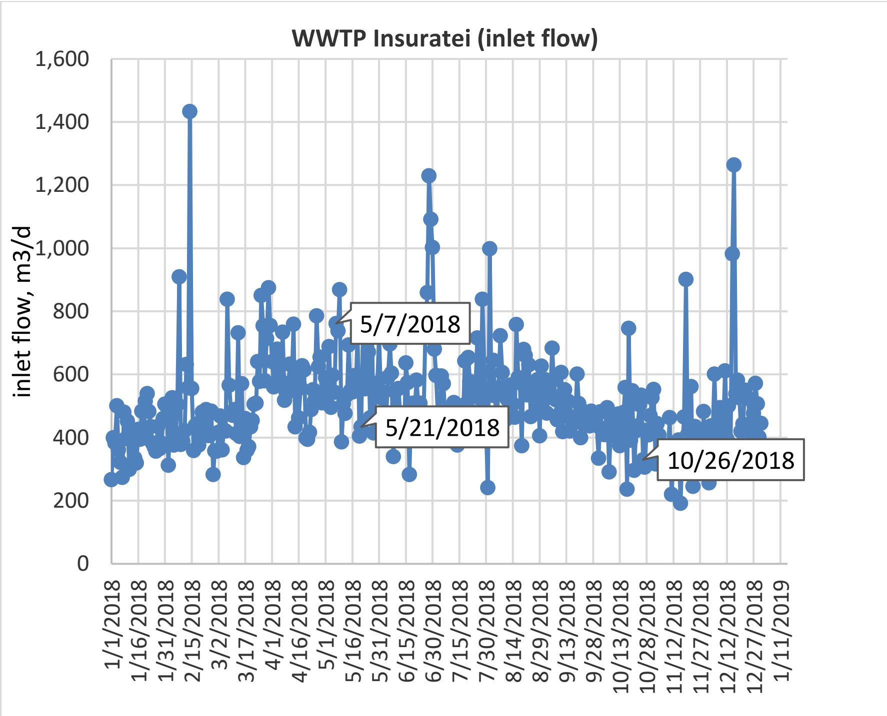
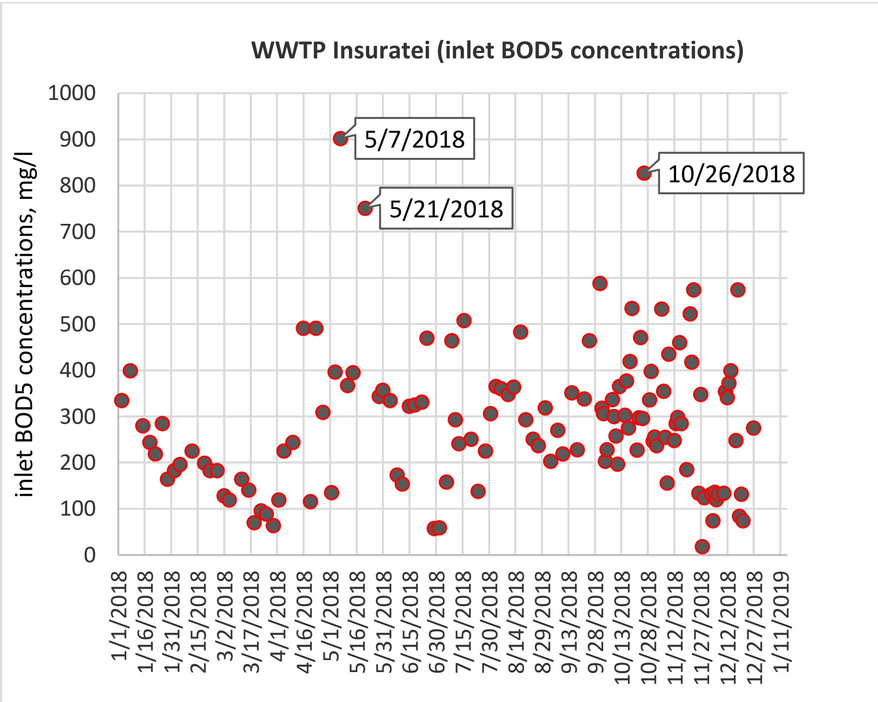


Figure 42: Inlet monitoring data for BOD5 concentrations at UWWTP Insuratei



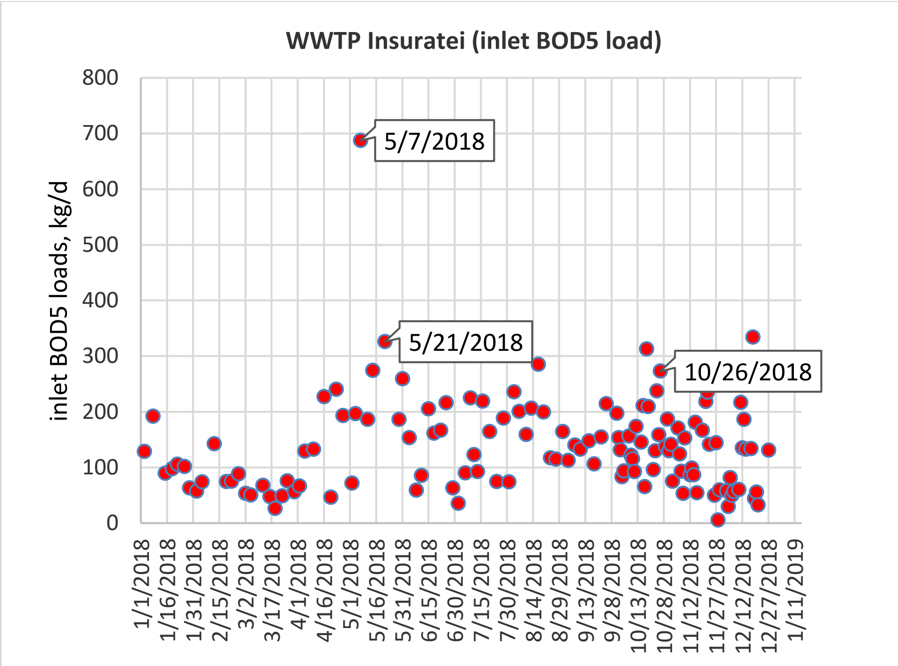


Figure 43: Results of calculate Inlet BOD5 load at UWWTP Insuratei

Analyzing the data, the inlet flow trend seems to be okay, although there is evidence for extreme rainfall events. There is no evidence however how the extreme rain events affect the inlet BOD5 concentrations and loads, since there was no monitoring data for inlet BOD5 concentrations during such events.

Analyzing the inlet BOD5 concentrations there are 3 extremely high values on 7.05.2018, 21.05.2018 and 26.10.2018, which are far beyond the range of all the other values. These values reflect also in high BOD5 loads. There was no evidence that these values are due to extremely high rainfalls. They can be due to random mistakes in sampling or analytical measurement. They are excluded from the data processing.

The available information is summarized in the following table:

Table 14: Summary inlet monitoring results of UWWTP Insuratei

WWTP Insuratei	Q	BOD5 max average weekly load
	m3/a	kg/d
Values	185 468	274
Nr samples	365	125

The maximum average weekly load of UWWTP Insuratei, in p.e., is: 274/0.06 = **4 569 p.e.**

Annex 5: Calculation of the pollution loads of Brasov and Codlea agglomerations

CALCULATION OF THE AGGLOMERATION LOAD FOR BRASOV AGGLOMERATION

1.1 Calculation of the usual resident population, as per 2018, in the Brasov agglomeration

Based on the newly delineated boundaries, Brasov agglomeration includes the settlements Brasov, Ghimbav, Sacele and SanPetru.

The usual resident population is determined according to Equation 3 (see details **in Chapter 3.**). The results are presented in **Table 15** below:

$$PR_{S,2018} = \frac{PR_{U/R,2018}}{PR\ U/R,2011}\ x\ PR_{S,2011}$$

(3)

Table 15: Calculation of usual resident population in 2018 for the settlements included in Brasov agglomeration

Settlements in Brasov aggl.	Total population ATU urban area, 2011 $PR_{U/R,2011}$	Total population ATU urban area, 2018 $PR_{U/R,2018}$	Total population in the settlement, 2011 $PR_{S,2011}$	Total population in the settlement,2018 $PR_{S,2018}$
	1	2	3	4
BRASOV	397,026	389,743	252,814	**248,176**
GHIMBAV	397,026	389,743	4,698	**4,612**
SACELE	397,026	389,743	30,798	**30,233**
SANPETRU	152,191	161,440	4,819	**5,112**

Source for columns 1, 2 and 3: NSI data base

The usual resident population within the agglomeration is determined according to Equation 4 (see details in **Chapter 3.**) and using information from the maps, about houses in the outskirts, which are not included within the boundaries (not ”sufficiently concentrated”).

The average number of residents per dwelling is calculated based on information by NSI, at county level, about the total number of dwellings in urban and rural areas (see details in **Table 16**).

$$PR_{AGG,2018} = (PR_{S1,2018} - PR_{EX,S1,2018}) + (PR_{S2,2018} - PR_{EX,S2,2018}) \ldots + (PR_{Sn,2018} - PR_{EX,SN,2018}) + PR_{IN,Sn+1,2018}) \quad (4)$$

Table 16: Calculation of average number of residents per dwelling

Brasov county	Total usual res. population	Total number of dwellings, 2018	residents per house
	1	2	3
Total County	551,183	252,473	2.18
Total urban area	389,743	189,116	2.06
Total rural area	161,440	63,357	2.55

Source for columns 1, 2: NSI

The calculations are given in . The total number of usual resident population within the agglomeration is:

$$PR_{AGG,2018} = 288\ 133 - 2691 = \mathbf{285\ 442}$$

Table 17: Calculation of usual resident population within the agglomeration boundaries

Settlements	***$PR_{S,2018}$***	***Average residents per dwelling***	***Excluded houses***	***Excluded population***	***Population within agg.boundaries***
	1	2	3	4	5
BRASOV	248,176	2.06	402	828	247,348
GHIMBAV	4,612	2.06	0	0	4,612
SACELE	30,233	2.06	367	756	29,477
SANPETRU	5,112	2.55	434	1,107	4,005
Total	**288,133**			**2,691**	**285,442**

Source for column 1: Table 15, column 4
Source for column 2: Table 16, column 3
Source for column 3: information from the agglomeration map

1.2 Calculation of the load collected by the sewer system (LaggC1)

In the case of Brasov agglomeration, all the generated load collected through the collecting system, enters WWTP Brasov, i.e. Equation 6 (see details in **Chapter 3.**).

$$L_{aggC1} = L_{aucEnteringUWWTP} \quad (6)$$

Generated load of the agglomeration addressed by UWWTP Brasov

There is an existing UWWTP (i.e. WWTP Brasov) with sufficient inlet monitoring data, allowing calculation of the average maximum weekly load, se per requirement of Art. 4(4) of the UWWTD. The maximum average weekly load of UWWTP Brasov is determined to be 268,637 p.e. (see **Annex 4** for more details). The UWWTP services the following settlements (based on information by APA BRASOV): Brasov, Ghimbav, Rasnov, Sacele, San Petru, Cristian, Harman and Poiana Brasov. The contribution of each settlement to the UWWTP is assessed based on the number of usual residents and tourists (if such) connected to collecting system/UWWTP.

The population connected to UWWTP Brasov for these settlements is presented in **Table 18**.

In the specific case, Poiana Brasov is a small settlement (379 residents in 2018) with very intensive tourist activities throughout the year. According to the NSI data, the maximum number of tourists in Brasov municipality was 155,121 nr, realized in August 2018.

- It is assumed that all the tourists are in Poiana Brasov, thus the average daily number of tourists is: 155 121/30 **= 5 171 nr/day;**
- It is assumed that all the tourist facilities are connected to UWWTP Brasov;
- The connection rate of residents in Poiana Brasov to the UWWTP is evaluated to be the same as for Brasov city (see the explanations below), i.e. the connected residents are 361 people. Thus, the total number of population and tourists in Poiana Brasov connected to UWWP is:

361 + 5171 = **5 532** (residents + tourists)

Table 18: Distribution of the load of UWWTP Brasov among the serviced settlements

Settlements serviced by UWWTP Brasov	Population and tourists connected to CS/UWWTP	Load distribution, %	Load distribution as p.e.
	1	2	3
Brasov	**236,197**	**81.63**	**219,300**
Ghimbav	**4,076**	**1.41**	**3,784**
Rasnov	14,800	5.12	13,741
Sacele	**17,209**	**5.95**	**15,978**
San Petru	**4,004**	**1.38**	**3,718**
Cristian	3,620	1.25	3,361
Harman	3,897	1.35	3,618
Poana Brasov	5,532	1.91	5,136
Total		**100**	**268,636**

The Brasov agglomeration load, connected to the UWWTP Brasov is evaluated to be:

219 300+3 784+15 978+3 718 = **242 780 p.e.**

According to the WSS Operator, all the industries are connected to the UWWTP Brasov. Thus, the load of the industrial emitters is included within the load treated by UWWTP Brasov.

Connection rates

The connection rate of the population of each settlement to the sewer collectors is calculated assuming that all the flats in the blocks are connected, i.e. only single, separate houses are not connected (if any). Information about the number of connected single/detached houses in 2018 was provided by the WSS Operator, based on signed individual contracts for provision of wastewater service with the owners of the houses (or based on number of single house connecting sewer pipes). Equation 9 and Equation 10 (see details in **Chapter 3**) are used, i.e.

$$TNDW_{aggC1} = NDW_{cond} + NFH_{aggC1} \quad (9)$$

$$TNDW_{aggC1} * PR_{DW,2018} = PR_{aggC1} \quad (10)$$

The total number of residential dwellings (both flats and single houses), as well as the total number of single/detached houses at settlement level is calculated in a similar way as the usual resident population in 2018, i.e. based on the data from census 2011 and the information for 2018 at ATU level, received by NSI.

The calculations are given in

Table 19 and Table 20. Example:

- calculation of total dwellings in Brasov settlement in 2018:

$$115\,573/116\,124 * 126\,901 = \mathbf{126\,299}\ nr$$

- calculation of total single houses in Brasov settlement in 2018:

$$(20\,631)/(115\,573) * 126\,299 = \mathbf{22\,546}\ \boldsymbol{nr}$$

Table 19: Calculation of total number of dwellings and the total number of houses at settlement level in 2018

Brasov agglomeration settlements	Total dwellings at ATU level in 2011	Total dwellings at settlement level in 2011	Total single houses at settlement level in 2011	Total dwellings at ATU level in 2018	Total dwellings in settlement in 2018	Total single houses in settlement level in 2018
	1	2	3	4	5	6
BRASOV	116,124	115,573	20,631	126,901	**126,299**	**22,546**
GHIMBAV	2,038	2,038	1,020	2,754	**2,754**	**1,378**
SACELE	11,078	11,078	6,928	11,257	**11,257**	**7,040**
SANPETRU	1,822	1,822	1,777	2,249	**2,249**	**2,193**

Source for column 1,2,3 and 4: NSI

Table 20: Calculation of usual resident population connected to collecting system and the respective connection rate in 2018

Brasov agglomeration settlements	Single houses connected to CS	Total dwellings in settlement in 2018	Total houses in settlement in 2018	Usual resident population in the settlement	Connection rate to CS for each settlement,%	Residents connected to CS
	1	2	3	4	5	6
BRASOV	16 450	126 299	22 546	248 176	**95.17**	**236 197**
GHIMBAV	1 058	2 754	1 378	*4 612*	**88.4**	**4 076**
SACELE	2 191	11 257	7 040	*30 233*	**56.9**	**17 209**
SANPETRU	1 706	2 249	2 193	*5 112*	**78.3**	**4 004**

Source for column 1: WSS Operator APA Brasov

Source for columns 2, 3: Table 18, columns 5 and 6;

Source for column 4: Table 15, column 4

Example:

- calculation of connection rate in Brasov settlement in 2018:

$$\frac{126\,299 - 22546 + 16450}{126\,299} * 100 = 95.2\%$$

- calculation of number of connected people in BRASOV settlement in 2018:

$$248176\ * 95.17\% = 236\,197$$

Similar calculations are made concerning the connection rate to UWWTP. In the case for Brasov agglomeration, the number of residents connecting to sewer collectors is the same as the number of people connected to UWWTP (i.e. there is no discharged of untreated sewer water into the river bodies).

1.3 Generated load of the agglomeration addressed by IAS

As mentioned in the methodology, it is considered that the load not currently connected to collecting system (and UWWTP) is generated by usual residents, living in these zones. Equations 13 and 14 are used:

$$PR_{agg\,2018} - PR_{aggC1} = PR_{aggIAS} \quad (17)$$

$$L_{aggIAS} = PR_{aggIAS} \quad (18)$$

Table 21: Calculation of usual resident population addressed by IAS

Brasov agglomeration settlements	Usual resident population within agg. boundaries	Usual res. population connected to CS	Usual res. population addressed by IAS
	1	2	3
BRASOV	247,348	236,197	11,151
GHIMBAV	4,612	4,076	536
SACELE	29,477	17,209	12,268
SANPETRU	4,005	4,004	1
TOTAL			**23,956**

Source for column 1: Table 17, column 5

Source for columns 2, 3: Table 20, column 6

1.4 Generated load of the BRASOV agglomeration

Based on the above calculations, the generated load of the BRASOV agglomeration is:

242 780 + 23 956 = 266 736 p.e.

CALCULATION OF THE AGGLOMERATION LOAD FOR CODLEA AGGLOMERATION

1.1 Calculation of the usual resident population, as per 2018, in the settlements belonging to the Codlea agglomeration

Based on the newly delineated boundaries, Codlea agglomeration includes only Codlea settlement. The usual resident population is determined according to Equation 3 (see details in **Chapter 3**). The results are in **Table 22**.

$$PR_{S,2018} = \frac{PR_{U/R,2018}}{PR\ U/R,2011}\ x\ PR_{S,2011} \qquad (3)$$

Table 22: Calculation of usual resident population in 2018 for the settlements included in Brasov agglomeration

Settlement	Total population ATU urban area, 2011 $PR_{U/R,2011}$	Total population ATU urban area, 2018 $PR_{U/R,2018}$	Total population in the settlement, 2011 $PR_{S,2011}$	Total population in the settlement,2018 $PR_{S,2018}$
	1	*2*	*3*	*4*
Codlea	*397,026*	*389,743*	*21,708*	***21,310***

Source for columns 1, 2 and 3: NSI data base

The usual resident population within the agglomeration is determined according to Equation 4 (see details in **Chapter 3**) and using information from the maps, about some houses in the outskirts which are not included within the boundaries delineation. The average number of residents per dwelling is calculated based on information by NSI, at county level, about the total number of dwellings in urban and rural areas (

Table 23).

$$PR_{AGG,2018} = (PR_{S1,2018} - PR_{EX,S1,2018}) + (PR_{S2,2018} - PR_{EX,S2,2018}) \dots + (PR_{Sn,2018} - PR_{EX,SN,2018}) + PR_{IN,Sn+1,2018}\ ) \qquad (4)$$

Table 23: Calculation of average number of residents per dwelling

Brasov county	Total usual res. population	Total number of dwellings, 2018	residents per house
	1	2	3
Total County	551183	252473	2.18
Total urban area	**389743**	**189116**	**2.06**
Total rural area	161440	63357	2.55

Source for columns 1, 2: NSI

The calculations are given in **Table 24**. The total number of usual resident population within the agglomeration is **21,186.**

Table 24: Calculation of usual resident population within the agglomeration boundaries

Settlements	*$PR_{S,2018}$*	*Average residents per dwelling*	*Excluded houses*	*Excluded population*	*Population within agg.boundaries*
	1	2	3	4	5
CODLEA	21,310	2.06	60	124	21.186

Source for column 1: Table 22, column 4
Source for column 2: Table 23, column 3
Source for column 3: information from the agglomeration map

1.2 Calculation of the load collected by the sewer system (L_{aggC1})

In the case of CODLEA agglomeration, all the generated load collected through the collecting system, enters WWTP Feldioara, i.e. Equation 6 (see details in **Chapter 3**).

$$L_{aggC1} = L_{aucEnteringUWWTP} \quad (6)$$

There is an existing UWWTP (i.e. WWTP Feldioara), which however has no sufficient inlet monitoring data, allowing calculation of the average maximum weekly load, se per requirement of Art. 4(4) of the UWWTD.

Therefore the generated load, connected to the sewer collecting system/UWWTP Feldioara, shall be collected as though there is no UWWTP, i.e. based on specific pollution rates for the different groups of emitters.

In this case, the generated load collected by the sewer system will be calculated by using Equation 7 (see details in **Chapter 3**):

$$L_{aggC1} = L_{aggC1,PR} + L_{aggC1,NonPR} + L_{aggC1,IND} \quad (7)$$

<u>*Load of usual resident population connected to the collecting system*</u>

The connection rate of the population of each settlement to the sewer collectors is calculated assuming that all the flats in the blocks are connected, i.e. only single, separate houses are not connected (if any). Information about the number of connected single/detached houses in 2018 was provided by the WSS Operator, based on signed individual contracts for provision of wastewater service with the owners of the houses (or based on number of single house connecting sewer pipes). Equation 9 and Equation 10 (see details in **Chapter 3**) are used, i.e.

$$TNDW_{aggC1} = NDW_{cond} + NFH_{aggC1} \quad (9)$$

$$TNDW_{aggC1} * PR_{DW,2018} = PR_{aggC1} \quad (10)$$

The total number of residential dwellings (both flats and single houses), as well as the total number of single/detached houses at settlement level is calculated in a similar way as the usual resident population in 2018, i.e. based on the data from census 2011 and the information for 2018 at ATU level, provided by NSI

The calculations are given in Table 25 and **Table 26**. In the case of Codlea, the ATU of Codlea, consists only of the settlement of Codlea.

Table 25: Calculation of total number of dwellings and the total number of houses at settlement level in 2018

Codlea agglomeration settlements	Total dwellings at ATU level in 2011	Total dwellings in settlement, 2011	Total single houses at settlement level in 2011	Total dwellings at ATU level in 2018	Total dwellings in settlement in 2018	Total single houses in settlement level in 2018
	1	2	3	4	5	6
CODLEA	8,054	8,054	3,316	8,236	**8,236**	**3,391**

Source for column 1,2, 3 and 4: NSI

Table 26: Calculation of usual resident population connected to collecting system and the respective connection rate in 2018

Codlea agglomeration settlements	Single houses connected to CS	Total dwellings in settlement in 2018	Total houses in settlement in 2018	Usual resident population in the settlement	Connection rate to CS for each settlement,%	Residents connected to CS
	1	2	3	4	5	6
Codlea	2,685	8,236	3,391	21,310	**91.42**	**19,482**

Source for column 1: WSS Operator APA Brasov
Source for columns 2, 3: Table 25, columns 5 and 6;
Source for column 4: Table 22, column 4

Example:

- calculation of connection rate in Codlea settlement in 2018:

$$\frac{8236 - 3391 + 2685}{8236} * 100 = 91.42\%$$

- calculation of number of connected people in Codlea settlement in 2018:

$$21310 \ * 91.42\% = 19\ 482$$

Similar calculations are made concerning the connection rate to the UWWTP. In the case for Codlea agglomeration, the number of residents connecting to sewer collectors is the same as the number of people connected to the UWWTP (i.e. there is no discharged of untreated sewer water into the river bodies).

<u>*Load of non-permanent residents connected to the collecting system*</u>

Codlea is not a settlement with intensive tourist activities. According to the NSI data base for 2018, the maximum number of tourists was in April and it was 926 people for the whole month. Thus the average daily number of tourists, i.e 31 is negligible.

Based on this analyses the load of non-permanent residents for Codlea agglomeration **is 0 p.e.**

Load of industrial emitters connected to the collecting system

No information was provided by the WSS Operator concerning the industrial loads within the settlement. It is known however that all the industrial emitters are connected to the sewer network. In case of lack of "specific case" information and following the precautionary principle (i.e. not to underestimate the loads), it is assumed that the industrial load is 20 percent of the generated load of the population within the agglomeration, i.e.:

21 186*0.20 = **4 237 p.e**. industrial contribution

Thus the generated load within Codlea agglomeration, connected to the collecting system is a sum of the respective loads of the connected resident population and the industrial emitters:

19 482 + 4 237 = 23 719 p.e.

1.3 Generated load of the agglomeration addressed by IAS

As mentioned in the methodology, it is considered that the load not currently connected to collecting system (and UWWTP) is generated by usual residents, living in these zones. Equations 13 and 14 (see details in **Chapter 3**) are used:

$$PR_{agg\ 2018} - PR_{aggC1} = PR_{aggIAS} \quad (13)$$

$$L_{aggIAS} = PR_{aggIAS} \quad (14)$$

Table 27: Calculation of usual resident population addressed by IAS

Brasov agglomeration settlements	Usual resident population within agg. boundaries	Usual res. population connected to CS	Usual res. population addressed by IAS
	1	2	3
CODLEA	21 186	19 482	1 704

Source for column 1: Table 10, column 5

Source for columns 2, 3: Table 12, column 6

1.4 Generated load of the CODLEA agglomeration

Based on the above calculations, the generated load of the Codlea agglomeration is:

23 719 + 1 704 = 25 423 p.e.

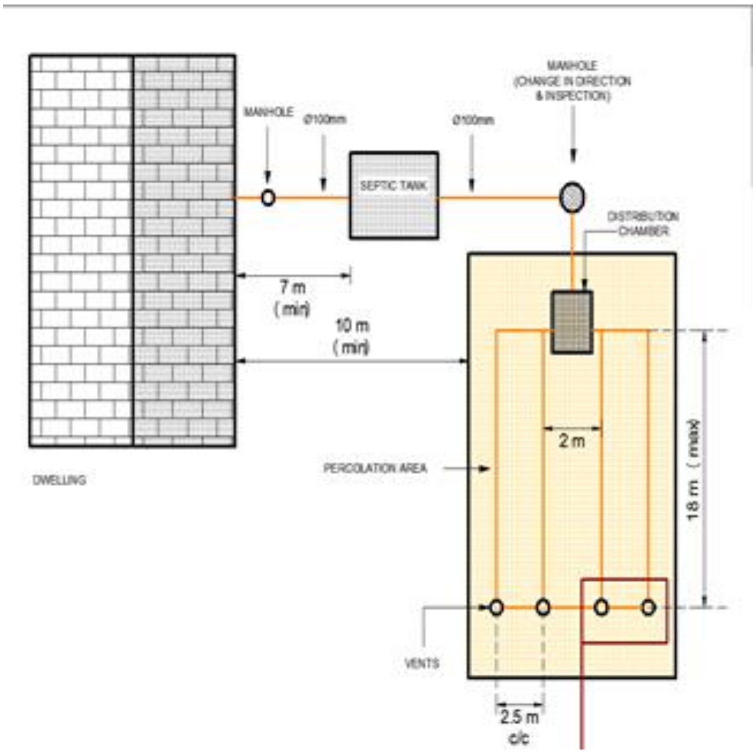
Annex 6: Description of the proposed examples of IASs: scheme, sub-options and description, sketch design, operational requirements, pollution removal, conditions and constraints for use, cost estimates

EXAMPLE IAS 1: SEPTIC TANK PLUS SOIL INFILTRATION SYSTEM

- Scheme and description

This IAS is a combination of two standardized units – septic tank and soil infiltration system.

Figure 44: IAS - 1 Septic tank plus soil infiltration systems



Source: Irish EPA,2009

- Sketch design

The system consists of two standardized treatment units – septic tank and soil infiltration system; hence the system should be designed based on their respective design requirements described below.

<u>Septic tank</u>

The EN standard specifies the design principles based on total pollution load per capita, minimum dimensions, minimum volume for the sludge chamber, *etc*. Even if the product has been tested and CE marked, there is still a need to tailor each product to the situation where it shall be used. However, the standards themselves do not provide a design methodology. Therefore, it is appropriate for the authorities to propose a design methodology. As mentioned above, guidelines with such methodologies exist in several countries. Here we refer to Irish EPA (2009) as this provides an easy to understand and very well elaborated example of such a guideline.

Irish EPA (2009) recommends the following formula to be used for determination of the tank volume:

$$C = 150 \times P + 2000 \quad (1)$$

Where C is the capacity (l) of the tank and P is the design population, whose wastewater will be discharged to the septic tank.

Irish EPA (2009) recommends a little bit higher minimal nominal capacity than the EN standards. It states that when population is less than 4, minimum capacity of 2.6m^3 should be provided in order to ensure sufficient retention time for settling of the suspended solids, while reserving an adequate volume for sludge storage.

Tilley, *et. al.* (2014) determined that the first chamber must be 50% of the total length, and when there are only two chambers it should be two thirds of the total length.

Soil Inflitration System

The design for the infiltration systems should ensure that wastewater will remain long enough in the soil. The residence time is controlled by the hydraulic loading and the rate of the flow into the sides. Thus, the main design criteria are based on:

- $A = Q_d$ / LTAR, where A is infiltration area (m^2); Q_d is average daily flow (m^3/d); and LTAR is the Long-Term Acceptance Rate associated with the soil and is found from the standard.
- *EN 12566-2:2005* provides an extensive methodology for site investigations.

Requirements for Pipework

- Pipework from septic tank to infiltration system should have at least same diameter as septic tank outlet and have a minimum slope of 0.5%.
- Distribution pipework should be slotted with diameter should be min. 80mm for gravity systems or 32mm for pressure systems.
- Infiltration pipes to be covered with geotextile to avoid ingress of fine particles.
- A ventilation pipe may be required to maintain low moisture levels.
- Access point is required at distribution point to monitor operations.

Infiltration Trench

- Trench width should be *min.* 0.5m;
- Trench length should be *max.* 30m (*max.* of 5 trenches);
- Distance between trenches min. 1m.

Table 28: Minimum total length of the trenches[29]

Number of people in the house	Minimum length of trench* (m)
4	**72**
5	**90**
6	**108**
7	**126**
8	**144**
9	**162**
10	**180**

*Note: *Trench width is 500mm and no individual trench length should be more than 18m.*

- Operational requirements

Septic tank

Waste that is not decomposed by anaerobic digestion has to be removed from the septic tank, otherwise the septic tank fills up and wastewater containing undecomposed material discharges directly to the drainage field. How often the septic tank has to be emptied depends on the volume of the tank relative to the input of solids, the amount of indigestible solids, and the ambient temperature (since anaerobic digestion occurs more efficiently at higher temperatures), as well as usage, system characteristics and the requirements of the relevant authority. Some health authorities require tanks to be emptied at prescribed intervals, while others leave it up to the determination of an inspector from the competent authority.

Irish EPA (2009) assumes that de-sludging of the septic tank is carried out at least once in every 12-month period, assuming formula (1) is used to determine the nominal tank capacity.

Soil Infiltration System

Since the bacteria in the trench walls and soil performs secondary treatment, the operational requirements for soil infiltration are limited to monitoring of soil to ensure it does not become water-logged which indicates that the soil permeability has dropped. When observed, the soil infiltration area must be re-located, or built-up with an additional layer of suitable soil (infiltration mound). If the soil infiltration is located remote, a pump station may be required to transport the wastewater from the septic tank to the infiltration area. Successful operations assume that the primary treatment stage (typically septic tank) is operated effectively, *esp.* septic tank sludge removed on a regular basis.

- Pollution removal

[29] Irish EPA Code of Practice (2009)

This system offers secondary treatment level.

- Conditions and constraints for use of this IAS

This IAS requires large area for the soil infiltration system. For single family (up to 4 persons) the minimum length of the infiltration pipes is 72m, which means that minimum area required for infiltration is *approx.*5mby 18m, or 90m^2. When minimum distance to the dwelling is added, the calculations show that an area of at least 300m^2 should be available to construct this IAS. Because of these considerations, the area availability is an important limiting factor for selection of this option (in addition to soil permeability).

- Cost estimates

The costs are a sum of the respective costs for septic tank plus soil infiltrtation system. The total investment cost starts from €2,110 (for 3-person family house). The total operational costs start from €140 (for 3-person family house).

Table 29: Investment costs for IAS 1 - Septic tank plus soil infiltration system (including installation)

	cost, €
Septic tank 2.6 m^3 and connections	1,530
Soil infiltration system	580
Total	**2,110**

Table 30: Annual operational costs for IAS 1 - Septic tank plus soil infiltration system

	cost, €/year
Cleaning 2 times/year	140
Total	**140**

- Summary table IAS 1: Septic tank plus soil infiltration system

The summary financial and treatment level information is shown in the table below.

Table 31: Summary information for IAS 1: Septic tank plus soil infiltration system

Item	**Values or description**
Treatment level	Secondary treatment
Investment cost for 3-person family house	From 2,110 €
Life time	30 years
Annual operational costs for 3-person family house	From 140 €/year

EXAMPLE IAS 2: Septic tank plus pre-treated effluent filtration system

- Scheme and description

Wastewater with low concentration of suspended solids (in treated primary or secondary stage) is discharged to a filter bed where a biomass is grown on the filter material (sand or gravel). Wastewater filters through the biomass layer where pollutants are adsorbed and treated. Reed beds may also be constructed to increase the level of wastewater treatment. Filtration systems may be either watertight (treated effluent discharged off-site) or may allow (partial) discharge to the soil similar to a soil infiltration system. An impermeable membrane (*e.g.* 0.2mm HDPE) is required to ensure watertight conditions. Depending on the discharge requirements, options may be selected for treatment of BOD and suspended solids, nitrogen and phosphorus.

Filtration systems are the subject of CEN/TR 12566-5:2008 “Small wastewater treatment systems up to 50 PT - Part 5: Pre-treated Effluent Filtration Systems”.

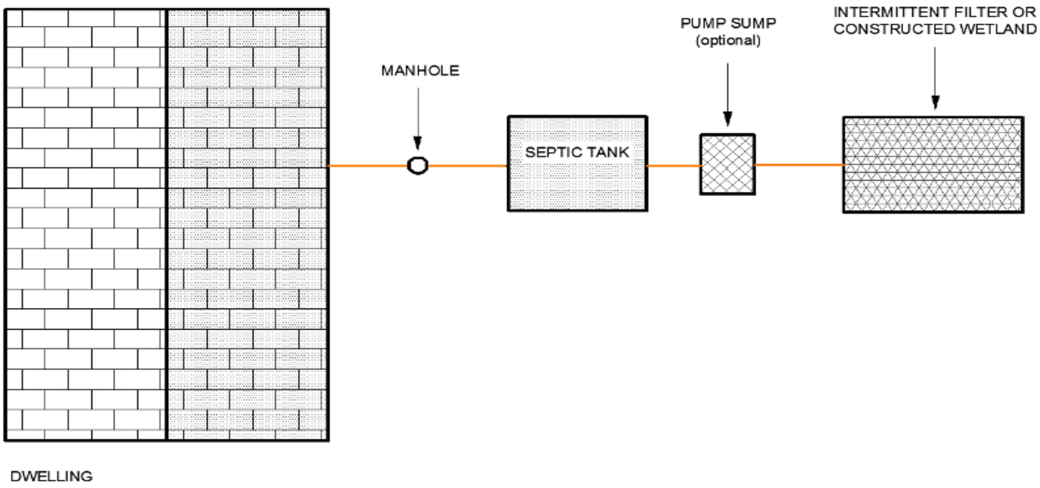
The range of filtration options includes: i) buried vertical sand filter; ii) covered vertical sand filter; iii) open vertical sand filter with reeds (vertical reed bed); iv) open vertical gravel filter with reeds (sometimes called vertical reed bed); v) open horizontal gravel filter with reeds. CEN/TR 12566-5:2008 provides a summary table when characterising the filtration systems.

Table 32:Types and characteristics of the filtration systems (CEN/TR 12566-5:2008)

Filter name	**Buried vertical sand filter**	**Covered vertical sand filter**	**Open vertical sand filter with reeds**	**Open vertical gravel filter with reeds**	**Open horizontal gravel filter with reeds**
Surface	Buried	Covered	Open with reeds		
Flow	Vertical	Vertical	Vertical	Vertical	Horizontal
Filter media	Sand	Sand	Sand	Gravel	Gravel

The selection of the filtration system will depend on the effluent requirements and site conditions. In general, O&M tends to be lowest for buried and covered vertical sand filters, and highest for open vertical gravel filters with reeds. The following indicates the most common applied sub-option selected, *viz*., buried vertical sand filter.

Figure 45: IAS - 2 Septic tank plus pre-treated effluent filtration system (buried vertical sand filter)



Source: Irish EPA Code of Practice (2009)

- Sketch design

The design requirements for septic tank are specified in the previous example.

CEN/TR 12566-5:2008 provides an extensive methodology for site investigations.

Requirements for Pipework

- Pipework from septic tank to filtration system should have at least same diameter as septic tank outlet and have a minimum slope of 0.5%.
- Distribution pipework should be slotted with diameter *min.* of 75mm for gravity systems or 32mm for pressure systems.
- Density and size of pipe perforations for dosing of wastewater to filtration options should be designed to meet a range of 3-15L/m^2 per dose in a maximum of 5 minutes, however limited to 3-6L/m^2 per dose in a maximum of 5 minutes for open horizontal gravel beds with reeds.
- Infiltration pipes to be covered with geotextile to avoid ingress of fine particles.
- A ventilation pipe may be required to maintain low moisture levels.
- Access point is required at distribution point to monitor operations.

Filtration Beds

- Frost insulation (air and water permeable) is required in cold temperatures;
- CEN/TR 12566-5:2008 provides details for dimensioning of filtration beds for all options, including reeds.

The table below provides some design considerations according to the Irish Code of Practice when sand filters are applied as a secondary stage.

Table 33: Design requirement for sand filters

Sand filter characteristics	Requirements
Minimum sand thickness	0.7-0.9m
Sand grain sizes	Soil covered - D_{10} range from 0.7 to 1.0mm Open filters - D_{10} range from 0.4 to 1.0mm Uniformity coefficients (D_{60}/D_{10}) less than 4
Hydraulic loading	20L/m^2.day (based on plan area) if 3 < P/T< 20 10L/m^2.day (based on plan area) if 21 < P/T < 75
Design criteria	
Sand layers	A number of beds of graded sand
Gravel protection layer	150mm of 8-32mm washed gravel
Infiltration laterals	$^{\varnothing}$32mm PVC with 4-6mm orifices at 0.3m spacing
Gravel distribution layer	250mm of 8-32mm washed gravel
Lateral centres separation	0.6m
Underdrain/collection system (required where T>90 and where discharge to surface water or offset polishing filter is proposed)	Washed durable gravel or stone 8-32mm. Slotted or perforated drain pipe $^{\varnothing}$75-100mm. Slope 0-1%.
Dosing frequency (controlled by on/off levels on pump)	Minimum 4 times per day (at equal time intervals for optimum treatment efficiency)
Pumping system	Pumps should be installed in a separate pumping chamber and only suitable wastewater treatment pumps with a minimum free passage of 10mm should be used.

Source: Irish EPA Code of Practice (2009)

- Operational requirements

All (dosing, distribution, sampling) chambers should be regularly monitored for blockage. For filtration systems with (partial) discharge to the soil, due to the fact that the bacteria in the soil performs post-treatment, the operational requirements for filtration include monitoring of soil to ensure it does not become water-logged which indicates that the soil permeability has dropped. When observed, the area for filtration must be re-located, or built-up with an additional layer of suitable soil (infiltration mound). If the filtration area is located remote, a pump station may be required to transport the wastewater from the septic tank to the filtration area. Successful operations assume that the primary treatment stage (typically septic tank) is operated effectively, *esp.* septic tank sludge removed on a regular basis.

- Pollution removal

Due to the substantial variation in performance levels, CEN/TR 12566-5 does not specify pollution removal efficiency for the various options. But these IASs can show very high rate treatment efficiency. BOD removal of 95% and nitrification of 90% have been measured using planted filter beds with 1m depth (Brix& Arias, 2005). Phosphorus removal could be achieved if special sand is used (as described in Annex 1 to CEN-/TR 12566-5).

- Conditions and constraints for use of this IAS

The filtration systems require a primary treatment system to remove particulate matter, typically a septic tank, prior to filtration and either effluent discharge to the soil or disposal off-site. They are applicable also as tertiary treatment stage, where effluent from the secondary stage is further treated. Different design criteria should be applied in dependence to the treatment level. Extremes of temperature, dryness, rainfall and snow should be taken into consideration when designing, constructing and locating the filtration system. Excavation depths for the filtration bed will depend on frost cover, depth to groundwater table and bedrock, depth of septic tank outlet. For filtration systems which are not water-tight, a minimum of 1.0m layer of unsaturated soil must be available above the highest level of the groundwater table, otherwise a raised system is required.

A detailed site investigation is required. When locating the site for the filtration system, the following minimum criteria should be ensured:

- Not subject to flooding;
- Minimum of 4m from inhabited dwelling;
- Minimum of 4m from road boundary or ditch;
- Minimum of 2m from boundary of adjoining site;
- Minimum of 10m from highest level of small water courses;
- Minimum of 3m from trees with extensive roots or crop areas under cultivation;
- No underground services shall be installed within the filtration area;
- No access roads or driveways shall be installed within the disposal area;
- Minimum 30m from groundwater sources.

Note that silty clay or clay or coarse gravel are unsuitable for direct infiltration. The filtration system is designed for domestic wastewater only (typically 150L/capita/day) and shall not accept storm water. An alternative design is required for commercial premises, e.g. restaurants, hotels.

Table 34: Investment costs for IAS - 2 Septic tank plus pre-treated effluent filtration system (including installation)

	cost, €
Septic tank 2.6 m^3 and connections	1,530
Sand filtration system	1,910
Total	3,440

Table 35: Annual operational costs for IAS - 2 Septic tank plus pre-treated effluent filtration system

	cost, €/year
Cleaning 2 times/year	140
Electricity	50
Total	**190**

- Summary table IAS - 2: Septic tank plus pre-treated effluent filtration system

The summary financial and treatment level information is shown in the following table.

Table 36: Summary information for IAS - 2: Septic tank plus pre-treated effluent filtration system

Item	**Values or description**
Treatment level	Secondary treatment
Investment cost for 3-person family house	From 3,440 €
Life time	30 years
Annual operational costs for 3-person family house	From 190 €/year

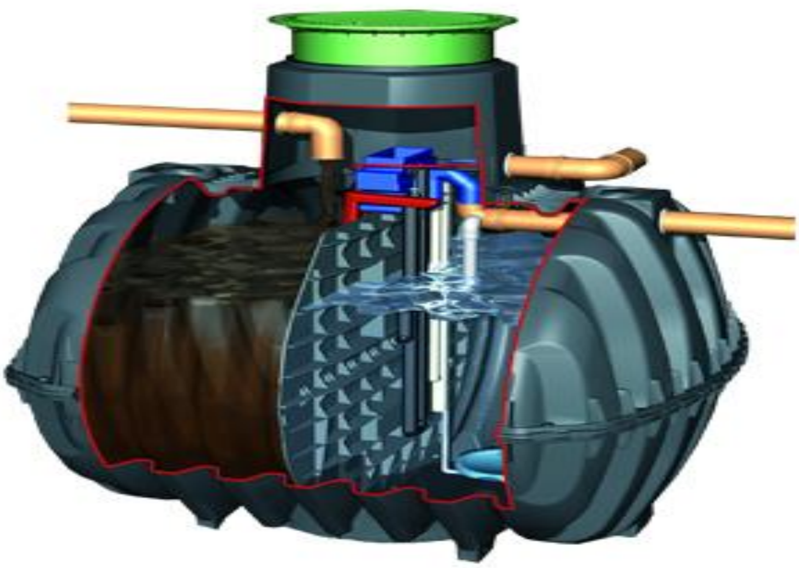
EXAMPLE IAS 3: PACKAGED WWTP

- Scheme and description

The major aim of the packaged WWTP is to ensure biological treatment of raw wastewater. In most cases these units also provide primary treatment (removal of solids), secondary clarification and sludge mineralisation. There are many different types of packaged WWTP systems. The biological stage may be with suspended activated sludge or with fixed-bed material (bio-filter). On the market, different modifications are available:

- activated sludge;
- submerged aerated filter;
- rotating biological contactor;
- sequencing batch reactor;
- peat filter media system;
- plastic, textile or another media system;
- membrane bioreactor system

Figure 46: Packaged WWTP - Sequencing Batch Reactor (SBR)



Source: Romanian supplier/www.instal-pompe.ro

The packaged WWTPs are subject to *EN 12566-3:2017: Small wastewater treatment systems for up to 50 PT - Part 3: Packaged and/or site assembled domestic wastewater treatment plants*. This standard requires that:

- Plants shall be structurally stable, durable, watertight and corrosion resistant.

    - Plants shall be provided with an alarm to indicate operational failure (*e.g.* electrical, mechanical or hydraulic failure). The manufacturer shall indicate which kind of failure is to be detected with the alarm.
  - Minimum internal diameters of inlet and outlet pipes for gravity flow:
    - 100 mm for nominal hydraulic daily flow < 4 m^3/d
    - 150 mm for nominal hydraulic daily flow > 4 m^3/d

- Design considerations

With respect to the design, the EN 12566-3:2017 requires the following design criteria to be taken into consideration:

  - Total population loading (Rules and units (per inhabitant, BOD, SS) to be used for the determination of the population pollution load should be given by national regulations);
  - Maximum and minimum daily loading that the plant accepts;
  - Minimum volume criteria;
  - Additional design criteria for domestic wastewater flows from sources such as hotels, restaurants or commercial premises. These additional design criteria are chosen according
  - Operational requirements

This treatment unit requires electricity for its operation. The owner is required to regularly monitor the operations. In case of failure, the unit would require specialized service. This is a significant risk for this IAS solution, consequently it is common for the Water Operator to regularly monitor and service the unit.

- Pollution removal

Normally, the pollution removal rate is sufficient for discharge to normal or “less sensitive areas” (Directive, Art. 6). Some packaged WWTP also offer higher N removal.

- Conditions and constraints for use of this IAS-2

The packaged WWTPs could be used as a single unit in an agglomeration, if there is available receiving water body in a normal or less sensitive area. In all other cases, tertiary stage will be necessary for post-treatment prior to discharge into soil or water body in a sensitive zone.

This IAS needs electricity to be operated. Many of the packaged WWTPs cannot operate effectively if there is no regular effluent since the treatment process is realised by microorganisms for which the wastewater is a food source. Thus, they may not survive without food for extensive periods.

- Cost estimates

Cost estimates are based on bill of quantity and Romanian unit costs. A 3-person family house is used for the calculations.

Table 37: Investment costs for IAS - 3 “Packaged WWTP” (including installation)

	Unit price	Quantity	Cost, €
Connections ø110	23 €/m	15 m	340
Outlet pipe to water body	100 €/unit	1	100
Connection to electricity	50 €/unit	1	50
Packaged WWTP	3,200 €/unit	1	3,200
Total IAS- 3			**3,690**

Table 38: Annual operational costs IAS-3 “Packaged WWTP”

	Unit price	Items	Cost, €/year
Removal of excess sludge	70 €/unit	2	140
Electricity	0.122 €/unit	400	50
Total IAS- 3			**190**

- Summary table IAS - 3: Packaged WWTP

Table 39: Summary information for IAS - 2: Packaged WWTP

Item	Values or description
Standardised with EN 12556	EN 12566-3:2017
Treatment level	Secondary treatment, some may provide Nitrogen removal
Need for other stages	If there is a receiving water body available, an additional stage would not be required. If no receiving water body available, another stage prior to soil discharge would be necessary
Design input data	Number of people
Site specific requirements	
Soil permeability	The IAS itself does not depend on the soil permeability, but discharge of the treated effluent should be ensured
Necessary area	From 3m^2

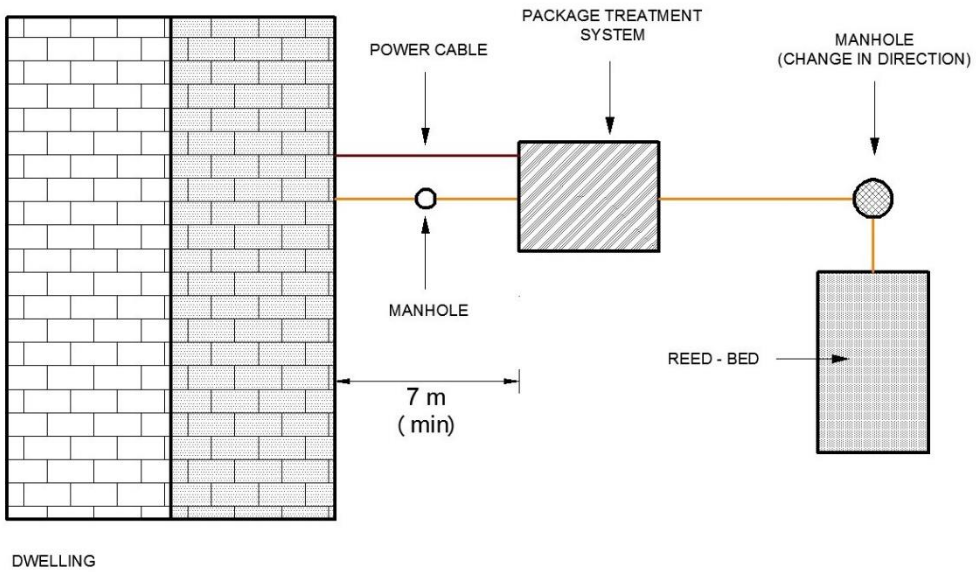
Item	Values or description
Minimum distance to the dwelling	7 m (Irish EPA Code of Practice, 2009)
Advantages and disadvantages	
Main advantages	• High treatment level • Small area • Fully automated process • Independence of climatic conditions
Main disadvantages	• Needs regular effluent • Specialized maintenance is required when breakdown occurs. Mechanical works require routine maintenance. • Might be inappropriate for temporal use
Life time	20 years
Investment cost (3-person family house)	From 3,690 €
Annual operational cost (3-person family house)	From 190 €/year

EXAMPLE IAS 4: PACKAGED WWTP PLUS REED BED

- Scheme and description

This IAS is a combination between IAS - 3 and a tertiary treatment unit. A variety of sub-options are possible fo the tertiary treatment unit such as soil polsihing filter, horizontal flow reed bed vertical flow reed bed - gravel etc. For illustration, a reed-bed system was selected.

Figure 47: IAS 4 Packaged WWTP and pre-treated effluent filtration system (reed-bed)



Source: *Inspired by Irish EPA Code of Practice (2009)*

- Sketch design

The system consists of two standardized units – packaged WWTYP and reed bed. The design consideration for the WWTP are described in the previous section and those for the reed bed are given below.

Table 40: Criteria for reed beds (tertiary treatment)

System Type	Area required*	Minimum system size	Loading rates	Length/width ratio
Horizontal flow reed bed - gravel (SFS)	$1m^2$/p.e.	$5m^2$	-	3:1
Vertical flow reed bed - gravel (SFS)	$1m^2$/p.e.	$5m^2$	$8L/m^2$ per dose (*max*.)	Can vary (but must ensure equal distribution)
Vertical flow reed bed - sand (SFS)	$3m^2$/p.e.	$15m^2$	5-$15L/m^2$ per dose for 2-5 doses per day	Can vary (but must ensure equal distribution)
Soil-based constructed wetland (FWS)	$10m^2$/p.e.	$50m^2$	-	5:1

*Source: Irish EPA Code of Practice (2009); SFS: sub-surface flow system; FWS: free-water surface; *Greater sizing may be required when discharging to nutrient sensitive waters.*

- Operational requirements

The operational requirements are described in the previous section.

- Pollution removal

This system offers tertiary treatment, allowing discharge of the treated effluent in sensitive zones.

- Conditions and constraints for use of this IAS

This IAS is appropriate when area is restricted, and a surface water recipient is available.

- Cost estimates

The costs are sum of the respective costs of IAS-I5 and IAS-I6. The total investment cost starts from €3,995 (for 3-person family house). The total operational costs start from €190 (for 3-person family house).

Table 41: Investment costs for IAS - 4 Packaged WWTP plus reed-bed (including installation)

	cost, €
Packaged WWTP	3,690
Reed-bed	305
Total	**3,995**

Table 42:Annual operational costs for IAS - 4 Packaged WWTP plus reed-bed

	cost, €/year
Cleaning two times a year	140
Electricity	50
Total	**190**

- Summary table IAS - 4: Packaged WWTP plus reed-bed

Table 43: Summary information for IAS 4: Packaged WWTP plus reed-bed

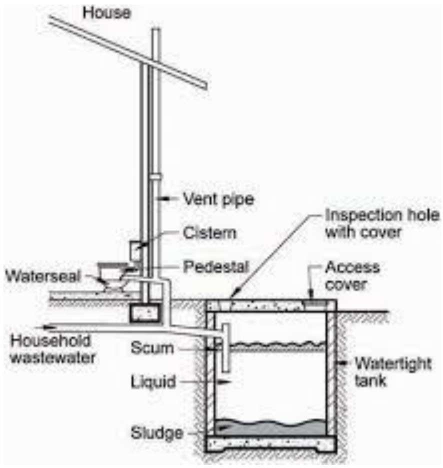
Item	**Values or description**
Treatment level	Tertiary treatment
Investment cost for 3-person family house	From 3,995 €
Life time	20 years
Annual operational costs for 3-person family house	From 190 €/year

EXAMPLE IAS 5: WATER TIGHT PIT

- Scheme and description

The pit serves for storage of wastewater from family houses, small hotels, restaurants *etc*., which have no possibility to discharge their wastewater into the existing sewerage system, water body or soil. A water-tight pit is a tank with one or more inlets, but with no outlet. It is emptied by special tankers (also known as "faecal machine"). The pit could be produced from different materials: high quality plastics, water-tight concrete, *etc.* In general, tanks are rectangular (when concrete is used) or cylindrical (when plastics are used). The wall thickness depends on the tank volume and the installation depth. Their construction should consider that the pit is exposed to a wide range of pressures on a regular basis - from filling to emptying the tank, pressure of the earth layer and the constant soil movement. Ventilation of the pit should be provided.

Figure 48: Water tight pit



Source: Inspired by Irish EPA Code of Practice (2009)

- Sketch design

The volume of the water tight pit, V (m^3), should be calculated using the following formula:

$V = QxNxT/1000$ (m^3)

Where Q is the water consumption per person per day (l/cap.d);

N – number of people, whose wastewater will be collected in the pit;

T – period between emptying (days).

When the local legislation requires minimum volume of the tank, prevention of improper design should be ensured.

- Operational requirements

This IAS requires consistent care. At regular intervals, depending on the volume of the tank, a vacuum tanker should empty the pit. This makes the IAS very expensive regarding the operational costs and ranks it as the most expensive among all other IASs. Further, wastewater is collected and transported to a WWTP for treatment. However, without a strict regime to monitor the delivery of wastewater to the treatment plant, there is a high risk of inappropriate disposal direct to the environment. A monitoring and enforcement regime are required to register emptying of the pit, delivery to a WWTP and a system of checking any discrepancy.

- Pollution removal

This IAS does not provide wastewater treatment, it only provides wastewater storage. Wastewater is collected and transported to a wastewater treatment plant or disposed to the sewerage system for subsequent transport to the treatment plant.

- Conditions and constraints for use of this IAS

Due to its very high operational costs and the need of additional treatment, the water tight pit should be selected only if no other possibility is available. For example, this is the only solution if the following conditions are in place: the soil is impermeable and there is no collection system or receiving water body nearby.

- Cost estimates

The investment costs of this IAS include: cost of materials and cost of installation or construction. Two options are considered: i) concrete pit and ii) plastic pit. Volume of 6m^3 is used in cost calculations, based on assumption of daily consumption of 150 l/cap/d, with 3 persons/house.

Table 44: Investment costs for IAS 5 “Water tight pit” (including construction/installation)

Investment costs	Unit price	Quantity	Cost, €
Option 1: Water tight pit 6 m^3 (concrete)	342 €/m^3	6 m^3	2,050
Option 2: Water tight pit 6 m^3 (plastic - polypropylene)	2,000 €/unit	1	2,000

Table 45: Annual operational costs IAS 5 “Water tight pit”

Operational costs	Unit price	Quantity	Cost, €/year
Emptying	70 €/unit	12	840

Table 46: Summary information for IAS 5: Water tight pit

Item	Values or description
Standardised with EN 12556	No
Treatment rate	0%
Need for other stages	This unit only stores wastewater; further transportation and treatment is needed.

Item	Values or description
Design input data	• Number of people served • Water consumption per person per day • Period between two emptying
Nominal capacity (suggestion)	• Minimum volume of 4.5 m3 for permanent living • Minimum volume of 2.5 m3 for temporary living
Site specific requirements	
Soil permeability	Appropriate for any soil type
Necessary area	2-3 m^2 plus distance to the dwelling and fences
Minimum distance to the dwelling	3 m (Irish EPA, 2009)
Advantages and disadvantages	
Main advantages	• Appropriate for any soil type • Does not require lots of space • Independent on climatic conditions • Appropriate for temporal use
Main disadvantages	• High operational costs • Needs regular emptyings
Life time	30 years
Investment cost for 3-person family house	From 2,000 €
Operational costs for 3-person family house	From 840 €/year

Annex 7: International experience on UWWTD implementation – country reports

The Portuguese Water Supply and Sanitation Sector and the Urban Waste Water Treatment Directive implementation

Country data

Portugal lies in Western Europe and has 10.3 million inhabitants, out of which approximately half are economically active. The population is concentrated in coastal areas, Lisbon and Porto having the highest population density, followed by Algarve (south) region.

For administrative purposes, Portugal is divided into 18 districts and 2 autonomous regions—the 11 islands of Azores and Madeira. The districts are further divided into 308 municipalities, 278 of which lie on the mainland and 30 belonging to the autonomous regions. The municipalities with the highest population are located along the Atlantic coast and clustered around the largest cities: Lisbon, and Porto and the region of Algarve.

Portugal became a member of the European Community, subsequently the European Union, in 1986. Water service provision at the time was unsatisfactory and wastewater treatment limited. Portugal adopted the EU Drinking Water Directive of 1998, the EU Urban Waste Water Treatment Directive of 1991, and the Water Framework Directive of 2000. As a result, the country was obliged to make significant investments in water and wastewater to meet the EU standards. It was also clear that the EU would make sizeable resources available, thereby rendering those large-scale investments feasible.

The Water Supply and Sanitation sector in Portugal

2.1 Background

Up to 1992, Portugal was facing little improvement in the water and sanitation services provided to the population. The country's financial capacity was limited, and the capital investment needed for the WSS sector was high. The Porto and Algarve regions required new water sources and Lisbon region needed wastewater treatment plants. And although these three regions were the priority, because of the urban pressure and concentration of population, the remaining country faced the same problems.

1992 KEY INDICATORS

- Water network coverage: < 82%
- Drinking water quality: < 50%
- Wastewater network coverage: < 60%
- Wastewater treatment: < 28%
- Coastal bathing waters quality: < 70%
- Inland bathing waters quality: < 30%

Source: ERSAR

Municipalities were exclusively responsible for water and sanitation systems, and their capacity to invest (both in financial terms and in skilled resources) was very limited. Additionally, at municipal scale it was difficult to design feasible Water and Wastewater Treatment Plants that could solve the challenges faced at that time.

Meanwhile, Portugal entered the European Union in 1986 and was receiving significant financial support from the EU.

The municipalities applied to funds and, here and there, local systems appeared. But the rate of investment was low, and results were far from what was expected. In fact, municipalities did not have the necessary skills and resources to absorb the EU funds and to invest them properly. In other words, capital investment was not being planned to respond to the needs of the country. Instead it was being directed to local, detached solutions, without national coherence.

KEY DATES

- Portugal in the European Union: 1986
- 1st Support from EU Fund € 1 182 million: 1986-88
- 2nd Support from EU – QCA I Fund € 8 519 million: 1989-93
- 3rd Support from EU – QCA II Fund € 17 458 million: 1994-99

Note: EU Fund to all eligible sectors (not only WSS)
Source: Ministério do Planeamento e da Administração do Território, 1995

The WSS sector was not efficiently organized to produce the required results. Reforms in laws and governance were necessary to comply with the EU directives and to improve the quality of service.

2.2 The 1993-95 Reforms

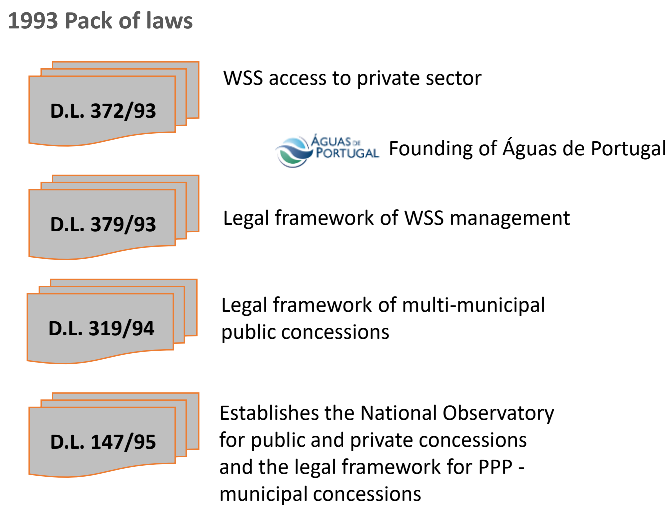
Until 1993 local authorities were exclusively responsible for constructing and operating water intake, treatment and distribution and wastewater collection, treatment and disposal systems.

In 1993, significant changes in law were introduced. To encourage a true water industry with the required investment capacity, private capital was given the opportunity to participate in the water and wastewater sector, although under the form of concessions.

Thus, two distinct concession models were created:

1. **Public companies:** multi-municipal systems between Government (51%) and Municipalities (49%), and;
2. **Private concessions** through international public tender promoted by the municipalities.

Following these alterations to the legislation it was possible to introduce a nationwide dimension to the problem of water sources and effluent disposal, aiming to guarantee standards of environmental safety and quality of the services provided, where the following factors were emphasized:



- Adequate management of water resources
- Development of the environment market in the water sector
- Acceleration of the rate of investment
- Access to private capital

Additionally, **AdP - Águas de Portugal** (Portuguese Water Company), a fully State-owned company, was created (1993) with the objective of participating with the municipalities in the multi-municipal companies to be created.

In 1995, a first generation of multi-municipal companies were created to solve the large urban areas' challenges: the water supply systems of Porto (Cávado and Douro and Paiva), and Algarve (Barlavento Algarvio and Sotavento Algarvio), and the wastewater treatment system of Estoril (in Lisbon region). In 2000 a "second generation" of multi-municipal systems to less populated regions were agreed with interested municipalities.

2.3 AdP-Águas de Portugal

AdP-Águas de Portugal (AdP) is a 100% state owned company, created in 1993 with a share capital of USD 160 million, subscribed through the incorporation of the existing Lisbon Utility, EPAL. With more than 100 years (founded in 1869), EPAL supplies the greater Lisbon region and was already owned by the State (this was the only utility that did not belong to the municipalities due to historical reasons). EPAL provided financial capacity and skilled staff to the newly created AdP.

AdP is, in its turn, owned by the Ministry of Finance, through two line public asset holdings.

AdP - Águas de Portugal objective is to increase quantitatively and qualitatively the percentage of Portuguese households served by drinking water and wastewater network systems, in an efficient and sustainable manner.

ÁGUAS DE PORTUGAL

- AdP - Águas de Portugal, a fully State-owned company.

100 %

EPAL

- Lisbon utility, EPAL is integrated in AdP. EPAL provided share capital, financial and technical capacity to leverage AdP.

51% % AdP
49 % Municipalities

- Multi-municipal systems to be created in large urban areas (1st generation) and afterwards in low density population regions (2nd generation).

Henceforth, the solution adopted to implement the multi-municipal systems involved the creation of regional public companies with the following shareholding structure:

- The State through AdP: 51% of the share capital;
- The municipalities supplied: 49% of the share capital;

The companies entrusted with management of the multi-municipal systems are responsible for the design, construction and operation of the “bulk” systems (water intake, WTP and mains up to the distribution systems and; WWTP and final disposal of treated effluent).

Downstream from the municipal water tanks it is the municipalities that must manage (or grant in concession) the distribution networks to consumers – the “retail systems”. They are also responsible for the sewerage networks (although these may also operate under concession), with the multi-municipal company's responsibility beginning at the wastewater main pipes.

Multi-municipal systems management model

- **Large scale systems**;
  100% public concessions from 20 to 50 years
- **Responsible for “bulk” services**:
  - Water treatment and supply to municipalities
  - Wastewater collection and treatment
- Responsible for the design, construction, maintenance and operation of the systems.
- **Downstream**, municipalities still manage (or grant in private concession) the distribution networks to consumers and also sewerage networks (“retail” service).

As these systems are created from scratch a substantial initial investment is required. This would be reflected in the tariffs to be charged, which render the solutions adopted unfeasible. It is thus necessary to resort to European Community financing - Cohesion Funds - with non-returnable investments of about 85% in the first generation of multi-municipal systems. Also, significant loans from European Investment Bank (EIB) were agreed to finance the Capital Investment Plan

Given its great scope, the substantial investments required, and the public nature of the service provided, the multi-municipal systems were designed so that:

- The Municipalities are simultaneously shareholders and clients of the multi-municipal companies
- Priority is given to large urban areas
- The concession periods are sufficiently long - 25-50 years
- There is a non-returnable investment by the State

Municipalities were asked to participate actively to determine the layout of the pipelines and of the location of water reservoirs to reduce problems in land acquisition and pipe-laying.

Detailed design (no tenders to design and build), to ensure budget control and reduce contingencies during the works. In the case of complex works (water treatment plants, dams, intakes) the degree of development of the design is reduced to attract new technologies available.

Use of surface intakes was encourage, allowing a proper design of the raw water reserves (this proved to be extremely useful and resilient due to prolonged draughts caused – probably – by climate change). Water quality and river pollution control upstream from intakes was guaranteed by the Environmental Authority.

Intake area are monitored so that alarm situations may be detected. And the design of "bulk" water tanks and mains was projected for daily average flows and not for peak flows. Pipe materials were selected on the basis of supply and assembly costs vs. expected useful life ratio.

Finally, flexible expansion plans were adopted to allow phased investment in terms of consumption increases and master plans were drafted to large urban areas.

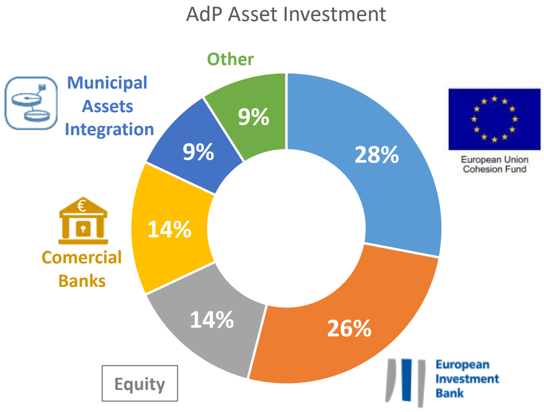
These public-public concessions are based on the principal of "full cost recovery", with the capital invested being recovered by a fair remuneration. The concession agreements determine that the return on equity to be recovered by tariffs results from the remuneration of share capital, legal reserves, retained earnings or dividends owed, at a rate equivalent to that of 10-year Portuguese Treasury Bonds plus a margin of 3%.

Therefore, the multi-municipal concessions' tariffs are regulated by accepted costs that cover operating costs, the amortization of investment net of grants, financial expenses net of financial income, income tax and the appropriate remuneration of equity.

All multi-municipal concessions also have a *goods and equipment renovation fund* in order to guarantee the proper condition of the system at the end of the concession period.

Between 1993-2015, AdP capital investment was about € 7.5 billion with the following financial sources:

Figure 49: AdP Asset Investment

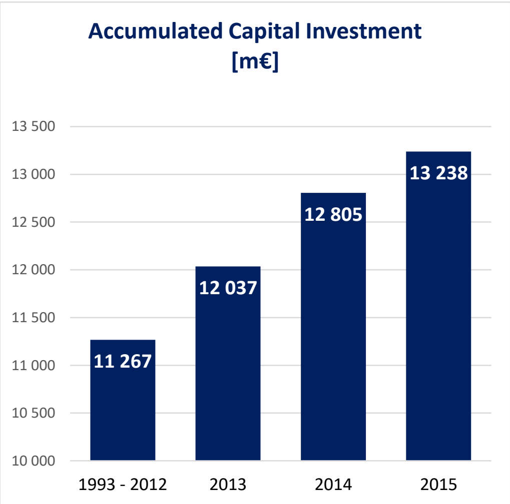


Source: AdP-Águas de Portugal

Nowadays, AdP- Águas de Portugal is the country's largest player, being responsible for supplying bulk water treatment services to about 80 percent of the population through multi-municipal companies.

2.4 Capital Expenditure and Financing

Between 1993 and 2015, 13,2 billion euros were invested, at an average of € 600 million per year.



CAPITAL INVESTMENT (Million €)	
WATER	7 124
Multi-municipal	3 760
Municipal	3 364
SANITATION	6 114
Multi-municipal	2 848
Municipal	3 266
TOTAL	13 238

Unit: Million €
Sources: ERSAR; GAG do PENSAAR 2020, AdP

Investment was distributed 50-50 for multi-municipal "bulk" systems and municipal "retail" systems. For water supply, € 7 124 million was invested, while the other € 6 114 million was applied in sanitation. To finance such investment, several sources were used, blending the "3 Ts" approach (Tariffs, Taxes and Transfers) and "blended finance". European Cohesion Funds were decisive to "contain" tariff growth. Also decisive was the support from the European Investment Bank, mainly to AdP-Águas de Portugal.

32 concessions and 5 joint companies (with shared equity between municipalities, 51%, and private operators, 49%) were awarded to private operators by 48 municipalities.

Altogether, € 6 390 million were obtained in the form of EU "lost funds" (transfers); € 3 450 million came from loans and private equity and; the remaining € 3 390 million from tariffs and taxes.

Figure 50: Funding Resources

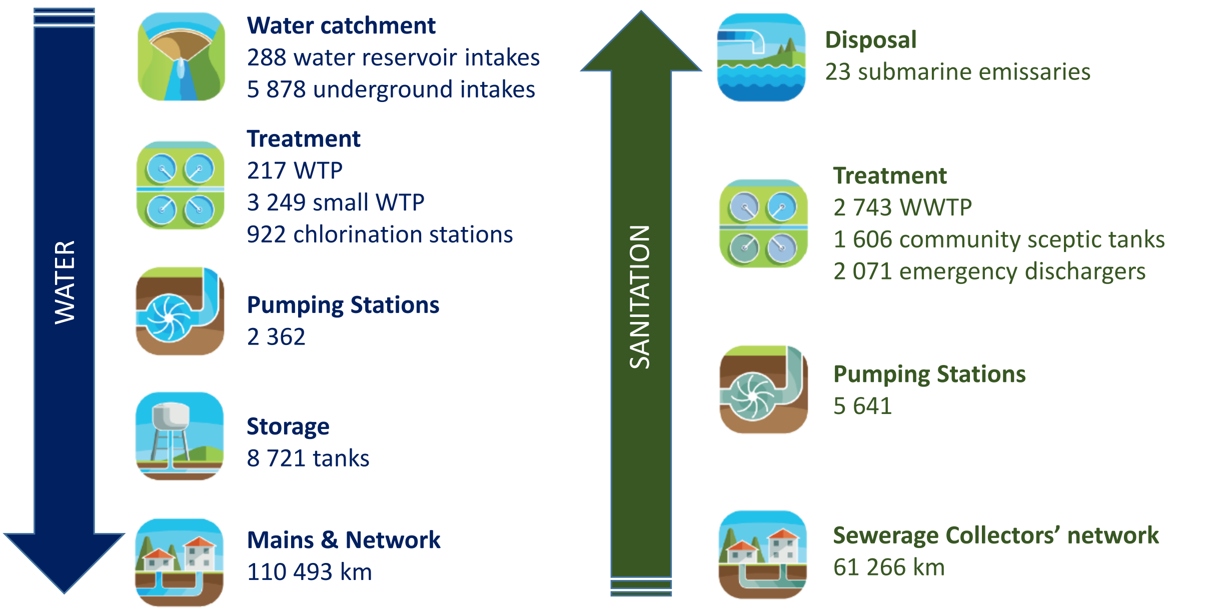
Funding Sources

European Union grants	€ 6 390 Million
European Investment Bank	€ 1 900 Million
Bonds – Private Placement	€ 600 Million
PPPs	€ 950 Million
Tariffs and Taxes	€ 3 390 Million

Sources: ERSAR, AdP-Águas de Portugal; PENSAAR 2020

2.5 Assets

As a result of the capital expenditure program for the last 25 years, the assets of country comprise 288 WTP (with only 5 serving 45% of the country's population - in Lisbon, Porto and Algarve), 110 thousand km of water mains and networks, 2 743 WWTP and 61 thousand km of sewerage networks:



Source: ERSAR

2.6 Tariffs

Tariffs to be charged to consumer include:

- Multi-municipal tariff
- Water distribution and sewerage collection tariff

Multi-municipal systems practice "full cost recovery", assuring sustainability and efficient asset management.

Municipalities are responsible to fix consumer's tariffs and may subsidize service to practice lower tariffs although "full cost recovery" is encouraged.

Domestic tariffs are composed by a fixed monthly charge plus a volumetric tariff usually comprising 4 blocks:

- Block 1 (social block): 0-5 m^3
- Block 2: 6 -15 m^3
- Block 3: 16-25 m^3
- Block 4: > 25 m^3

Other consumers (State, municipalities, industry, commerce), also have a fixed monthly component and a volumetric charge usually equal to the 3rd Domestic Block.

A significant number of municipalities also have a pro-poor tariff and a "large family" tariff.

In 2017, the average tariff to consumers reached € 1.91 for both services – water and sanitation.

In terms of affordability, the average tariff for water (1.09 €/m^3) represents 0.38% of the average household income (for a consumption of 120 m^3/month). The average tariff for sanitation (0.82 €/m^3) represents 0.29% of the average household income.

Therefore, the cost of service combined (water and sanitation) for an average family represents only 0.67% of the income of such family.

TARIFFS ENSURE AFFORDABILITY	
WATER TARIFF (€)	
Average Multi-municipal Tariff	0,49
Average Tariff to Consumers	1,09
SANITATION TARIFF (€)	
Average Multi-municipal Tariff	0,51
Average Tariff to Consumers	0,82

Source: ERSAR, RASARP V1, 2018

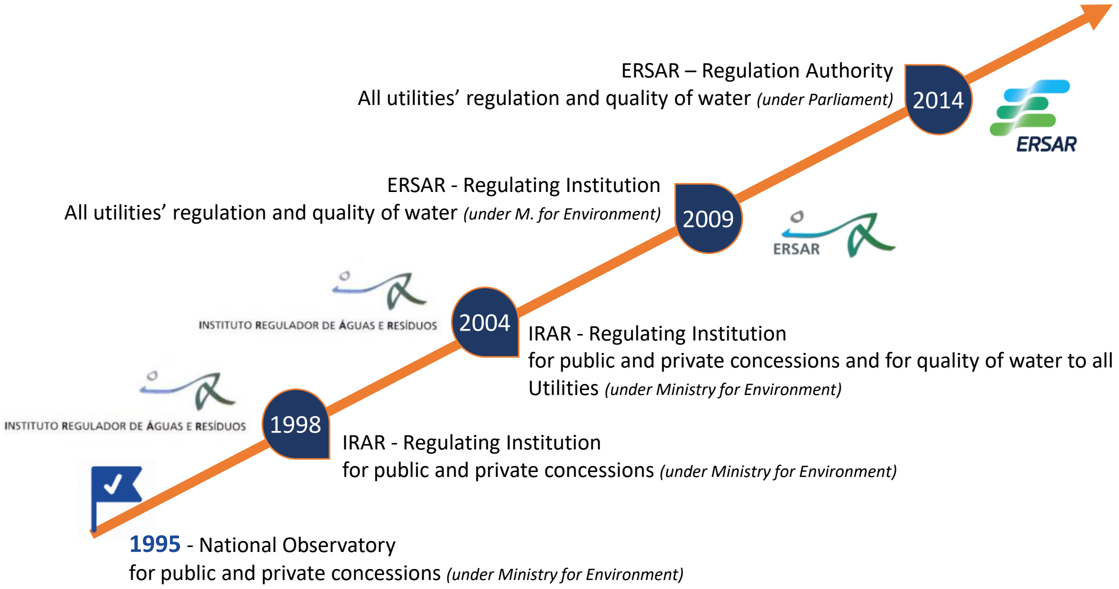
Nonetheless, many municipalities also have a pro-poor "Social Tariff" with discount over the 1st and 2nd blocks of tariffs.

2.7 The Regulator

The water sector is regulated by the Water and Waste Services Regulation Authority (ERSAR). In 2017, a total of 435 entities were providing WSS services, including state-owned utilities, municipalities, and private sector operators in both bulk and retail services.

ERSAR started in 1995 by being just an "observatory" for multi-municipal and municipal systems, focused on procurement. Then in 1997 it evolved and became an institution (*Instituto Regulador de Águas e Resíduos, IRAR*) and in 2016 it became the Regulation Authority.

Regulation: National Authority evolution: 1995 to present



ERSAR is the regulation authority for drinking water supply, wastewater management and municipal waste management and the national authority for drinking water quality.

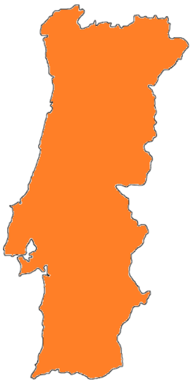
It aims to ensure adequate protection for consumers and users of water supply and waste services by promoting the quality of service rendered by the operators and guaranteeing socially acceptable pricing, materialized in the following principles: essentiality, indispensability, universality, equity, reliability and cost efficiency associated with the quality of the service.

However, this should be carried out in view of safeguarding the financial viability and best interest of the operators, irrespective of their status (public or private, municipal or multi-municipal) and also taking into account the economic aspects through the consolidation of the business framework, while also contributing to the implementation of government policies.

ERSAR also ensure that there is equality and transparency in access to the water and waste services and their operation and respective contractual relationships, as well as consolidating an effective public right to general information regarding the sector and each of the operators.

2.8 Key Indicator's evolution

In Portugal, public water supply is universal, covering 96% of all households in the country while wastewater collection covers 84% of the households.



- **Area: 92,2 thousand km²**
- **Population: 10,3 million**
- 96% water public network coverage (99% in urban areas)
- 98,9% safe drinking water
- 84% wastewater public network coverage (*) with wastewater treatment (97% in urban areas)

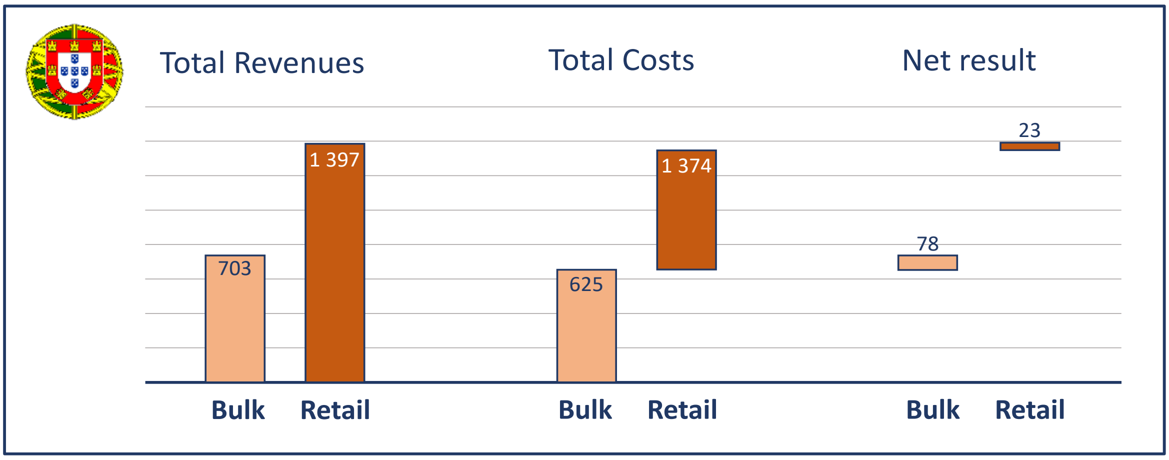
(*) only considering the public network systems

- Water supply: 598 million m³/year
- Non Revenue Water: 30,2%
- Total per capita consumption: 192 l/inh.day
- Domestic per capita consumption: 126 l/inh.day

Source: GAG do PENSAAR 2020

With an average positive net result, the WSS services in Portugal are sustainable, although a significant part of (small) municipalities still subsidize their services, hence opting for maintaining tariffs at a low price and below total cost recovery.

Figure 51: Financial sustainability of the WSS in Portugal



Unit: million euros; Source: ERSAR

The Urban Waste Water Treatment Directive in Portugal

Since the accession of Portugal to the EU in 1986, the progressive transposition of Community law in general and of the environment in particular has been taking place. With regard to the protection of water resources - especially in the area of water quality - Portuguese law has begun a process of harmonization with the other Member States - which part of the doctrine has been called Europeanization of Water Law - which culminated in the transposition of the Water Framework Directive (WFD) in 2005.

In 21 May 1991 the European Council launched the Directive 91/271/EEC, which became known as the Urban Wastewater Treatment Directive (UWWTD) aiming to regulate the treatment of the urban wastewater. The Directive 91/271/EEC was subsequently amended by the Directive 98/15/EC of the European Commission of 27 February 1998, which amends the Annex I of the Directive 91/271 / EEC as regards requirements for discharges of urban waste water treatment plants into sensitive areas subject to eutrophication and also by the Regulation (EC) Nº 1882/2003 of the European Parliament and of the Council of 29 September 2003.

The Directives were transposed into Portuguese legislation, respectively, by Decree-Law 152/97, which also approved the list of sensitive areas and less sensitive areas for the continental territory, and by Decree-Law 348/98 (to transpose the amendments defined on the Directive 98/15/EC).

However, since Decree-Law 152/97 had only effect at Portuguese mainland and considering the need to ensure coordination that would allow the full compliance with the Directive 91/271 / EEC, Decree- Law 261/99 extended to the Autonomous Regions of the Azores and Madeira (the eleven Portuguese islands) the obligations contained therein and to amend Annex II of Decree-Law 152/97, concerning to the delimitation of less sensitive areas.

Subsequently, Decree-Law 172/2001 amended Annex II of Decree-Law 152/97 regarding the identification and delimitation of sensitive areas. Given the need for periodic reviews of sensitive areas and less sensitive areas, Decree-Law 149/2004 revised those areas and defined for sensitive areas identified under the eutrophication criterion, their area of influence. For the other zones, designated under the other criteria, it was established that the area of influence should be determined casuistically.

Finally, Decree-Law nº 198/2008 revised the sensitive and less sensitive areas and defined as the area of influence of these zones the basin of the sensitive zone, excluding in some cases the basin area correspondent to the upstream limit of the sensitive zone. It also established that the requirements for urban wastewater discharges from agglomerations with a size of more than 10 000 p.e. are to be applied simultaneously to nitrogen and phosphorus, when located in sensitive areas subject to eutrophication. Finally, for the areas where the identification criterion arises from non-compliance with other directives, the parameters responsible for this non-compliance were indicated.

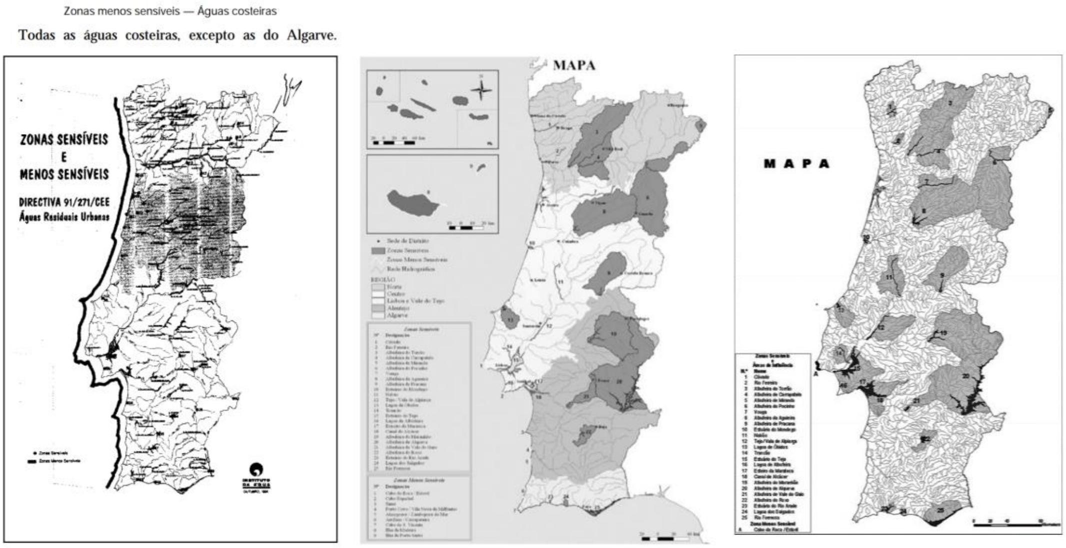
Due to the need for a new revision of the delimitation of less sensitive areas, in particular as regards the areas designated for the Autonomous Region of Madeira, Decree-Law nº 133/2015 eliminated the classification as a less sensitive area the coastal waters of the northern side of Madeira's island and of all the coastal waters of the Porto Santo's island.

The list of sensitive and less-sensitive areas should be, according to the EU Directive, revised each 4 years. The revision of the sensitive and less-sensitive areas should be supported by technical and scientific studies, such as water quality mathematical models.

The revision of the sensitive and less-sensitive areas can lead to the identification of new areas, and respective basins of influence, to more exigent discharge limits for certain parameters, as well as to the declassification of areas previously identified as sensitive and non-sensitive, where the studies allow to conclude for an improvement in the environmental conditions which no longer justify the classification.

Portugal has revised the classification of the sensitive and non-sensitive areas, according with the Directive. Since DL 152/97 the maps with the delimitation of the sensitive and less-sensitive areas have been changing, as can be seen in the pictures below.

Delimitation of the sensitive and less-sensitive areas successively identified by the Portuguese Water Authority (APA)



1997 (DL 152/97) 2004 (DL 149/2004) 2008 (DL 198/2008)

Sensitive areas are designated where there are agglomerations ≥ 10 000 p.e. which reject in:

- Water bodies that are eutrophic or likely to become eutrophic in the near future if protective measures won't be taken
- Water bodies intended for the abstraction of drinking water with a nitrate content exceeding 50 mg / l of nitrates;
- Areas where a treatment more exigent than secondary treatment is necessary to comply with Council directives, in particular those relating to fishery waters, bathing waters, bivalve mollusk production waters and surface water abstractions intended for the production of water for human consumption.

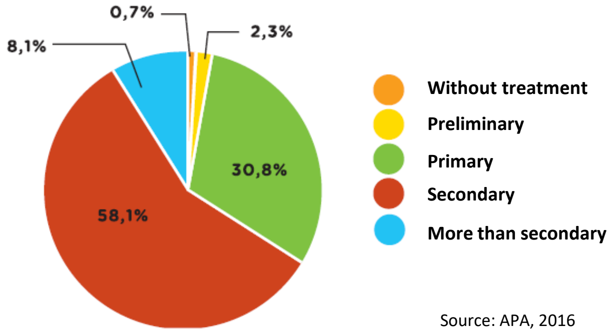
In 2014, Portugal had 444 urban waste water agglomerations of more than 2 000 p.e. These agglomerations generated a total load of 12 035 660 p.e. These agglomerations are connected to 1 primary treatment plant, 290 secondary treatment plants and 173 more stringent treatment plants. All these treatment plants have a total design capacity of 16 593 694 p.e. The majority of population is concentrated in agglomerations between 2 000 and 10 000 p.e. There are 14 agglomerations with a load ratio greater than 150 000 p.e. representing about 41% of the total load generated.

3.1 Wastewater Treatment in Portugal

Portugal has 2 743 Wastewater Treatment Plants (WWTP) and 1 606 community septic tanks. Most of these WWTP are local small units (below 2 000 p.e.).

1 556 WWTP were built between 2005 and 2018.

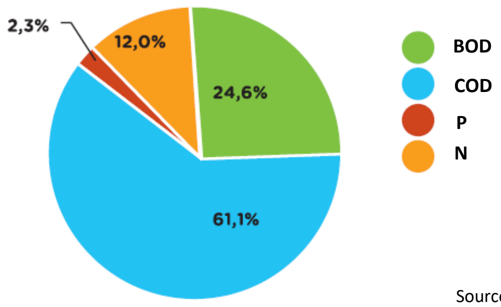
Overall load of these WWTP is estimated to be 15.6 million p.e. with the level of treatment here represented.



Source: APA, 2016

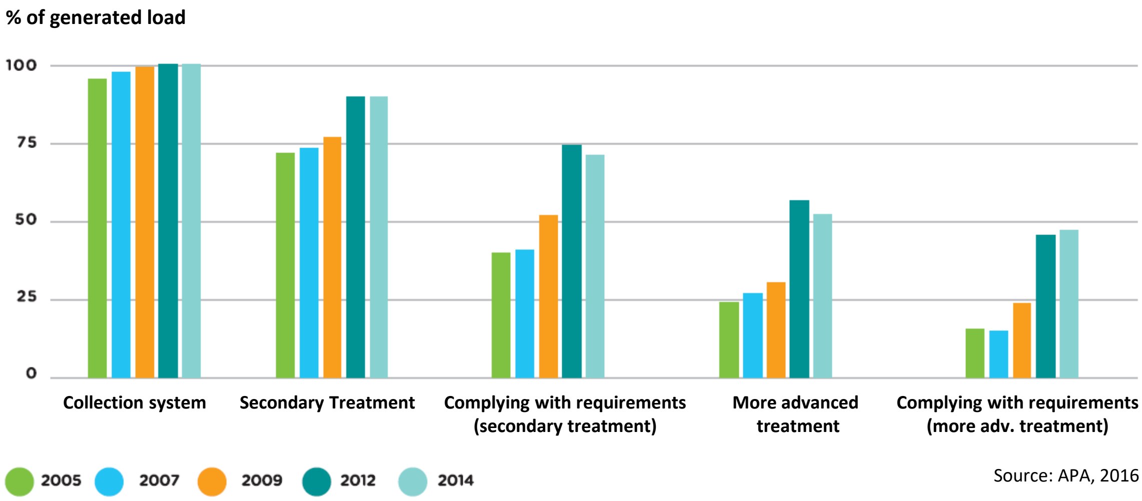
Most of the WWTP are equipped with a secondary treatment, followed by the typical primary treatment of small installations (usually less than 1 000 p.e.).

As for the treated load expressed as a percentage of the BOD, COD, N and P, it is verified that the load of COD is rejected in greater quantity than the remaining parameters.



Source: APA, 2016

Regarding the compliance with Directive 91/271 / EEC, between 2005 and 2014, the evolution of compliance with this Directive in Portugal has been very positive. Since December 2014, the collected load is almost 100%.



Source: APA, 2016

Portugal did not do a specific work on establishing agglomeration boundaries in the past. However, during the preparation of WSS investments feasibility studies assess sufficiently concentrated areas to account for avoidance of excessive cost in achieving environmental benefits and compliance with UWWTD. Use of individual appropriate systems (IAS) is widespread. ERSAR issued a quality assessment guide for water and waste services provided to users (3rd generation of the evaluation system). In its assessment the regulator is monitoring an indicator "number of dwellings located in the area of intervention of the management entity with individual solutions of wastewater (e.g. septic tanks) for which the sludge and wastewater removal service is provided by the managing body through its own mobile and or third-party means". The legislation requires that municipal wastewater services in urban areas cover the collection, drainage, elevation, treatment and rejection of urban wastewater, as well as the collection, transport and final destination of sludge from individual septic tanks. So the service of cleaning of septic tanks constitutes a public service obligation and the management entities of the sanitation service ensure the cleaning of septic tanks to the properties located more than 20 meters from the public sanitation network (through own or third-party means). Because they are alternative services (in the user's perspective), ERSAR has been recommending that the tariff structure to be adopted for the cleaning of individual septic tanks is integrated into the general tariff.

3.2 The Estoril coast derogation

Estoril is a coastal area some 30 km. away from the capital – Lisbon. Its hydrological basin is heavily populated and until 1990 no wastewater treatment was available. Between 1990 and 1995 a “collector ring”, alongside with a preliminary treatment plant were built. And a 3 km submarine emissary rejected the effluent to the sea.

Article 8 (5) of Directive 91/271 / EEC provides a concession whereby, in exceptional circumstances, discharges in less sensitive areas of wastewater from agglomerations exceeding 150 000 population equivalents may nonetheless be subject to the less stringent requirements set out in Article 6 (2).

In such circumstances, Member States are required to submit beforehand the relevant documentation to the Commission, showing that the discharges receive at least primary treatment and that they will not affect the environment.

On 16 June 1999 Portugal sent a request to the Commission under Article 8(5) of Directive 91/271/EEC, concerning the discharge of wastewater into the Atlantic Ocean near the Tagus estuary, from the agglomeration of the Estoril coast, which accounts for 720 000 population equivalents.

The hydrodynamic conditions of the western coast of Portugal, which result from the wind conditions, tides, currents and dispersion, are some of the most favorable of European coastal waters for the dilution and dispersion of waste water. Moreover, the point of discharge is situated outside the outer limit of the Tagus estuary and is far away from the bathing areas of the Estoril coast.

The documentation transmitted by Portugal under the process demonstrated that the discharge will not have any impact on the dissolved oxygen rate, the trophic status, the transparency and the benthic community of the receiving waters.

The request by Portugal was accepted by the European Union, by the Commission Decision 2001/720/EC, 8 October 2001, granting Portugal a derogation regarding urban wastewater treatment for the agglomeration of the Estoril coast and imposing lower levels of treatment.

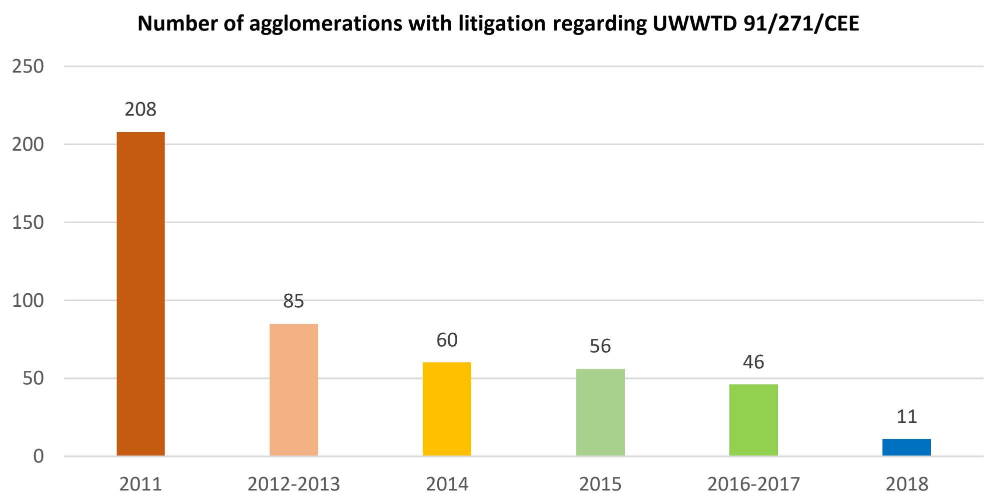
Upgrading works were implemented between 2007-2012 (the Guia WWTP is completely subterranean, constructed in an artificial grotto) and the "new" WWTP of Guia is now complying with the 2001/720/EC decision.

With an area of 4 600 m^2 on two underground floors and 30 meters deep, the WWTP treats around 150 000 m^3/day and has production capacity of 9 000 m^3/day of water for reuse, for example, in the irrigation of gardens, golf courses and street washing.

3.3 Litigation between Portugal and the European Union

Regarding non-compliance with the UWWTD, the reporting to the EC in 2018 - with data for the year 2016 - stated 16% of cases of non-compliance. For these cases, measures were taken with an investment of around € 254 million for urban WWTP and € 10 million for urban wastewater collection and drainage networks. This investment was programed for the period 2013 - 2022.

Currently, Portugal has two infringement proceedings (in 11 agglomerations) for non-compliance with article 4 (secondary treatment) and article 5 (more advanced treatment in agglomerations with generated load above 10,000 p.e. and discharging in sensitive zones).



Source: GAG PENSAAR 2020, 2018

As regards the 1st case concerning small agglomerations (<15 000 p.e.) for failure to comply with Article 4, out of the 44 agglomerations initially incorporated in that litigation, only 10 still don't meet all the requirements, of which 4 are in construction phase and the remaining are in the process of stabilizing the treatment process (WWTP testing phase). It is envisaged that by 2020 all agglomerations will fully comply with UWWTD requirements.

The Cyprus Water Supply and Sanitation Sector and the Urban Waste Water Treatment Directive implementation

Background

1.1 Geopolitical situation: Area under Government's Control

The island of Cyprus is in the Eastern basin of the Mediterranean. It is the third largest island in the Mediterranean Sea after Sicily and Sardinia - with a surface area of 9.251 km^2. The Republic of Cyprus was established in 1960, when the island gained its independence from Great Britain. However, the invasion of the northern part of the island by the Turkish army in 1974, and ensuing internal displacement of populations, has led to a de facto partition of the island. Since 1974, it has been separated along ethnic divides between the so-called Greek Cypriot Community in the South and Turkish Cypriot Community in the North[30].

Figure 52. Map of Cyprus illustrating the Green Line Divide

source: The World Bank, 2004

Since then, the Republic of Cyprus controls only the southern 60% of the island (Figure 52). It is the only internationally recognized government of the island. The north of the island (about 37% of the territory) falls outside of government's control. The island's division is materialized by a buffer zone or "green line", under the control of the United Nations. Although many efforts have been made in the last decades under the auspices of the United Nations to settle the Cyprus issue, the country remains divided. The Republic of Cyprus formally applied for membership to the European Union (EU) in 1990. After signing the Treaty of Accession in 2003 Cyprus became an EU Member State on May 1, 2004. On January 8, 2008, Cyprus also became a member of the Eurozone. A separate protocol of the Treaty of Accession regulates the status of the northern part of Cyprus as "areas of the Republic of Cyprus in which the government of the Republic of Cyprus does not exercise effective control." The effectiveness of EU laws is suspended in the northern part of Cyprus until the EU Council unanimously

[30] Following the invasion, a total of 165,000 Greek-Cypriots lost their homes and were displaced to the Southern part of the island that remained under government's control, while 45,000 Turkish-Cypriots were displaced to the Northern part (United Peacekeeping Forces in Cyprus, UNFYCIP). In 1974, the population on the island was estimated at about 640,000 of which Greek Cypriots represented about 85% of the total.

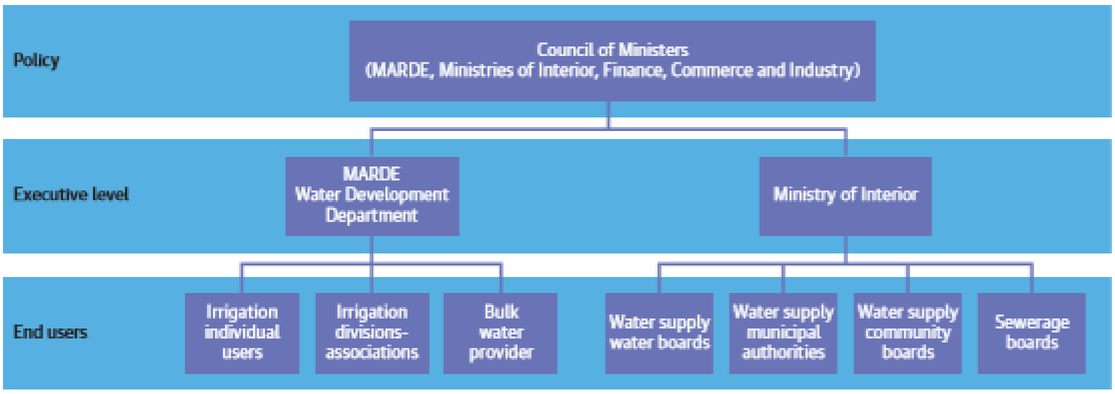
decides otherwise. Turkish Cypriots (as opposed to Turkish settlers) are considered EU citizens even though they live outside of the government-controlled areas.

This report presents a concise summary of the experiences and challenges in the implementation of the Urban Waste Water Treatment Directive (UWWTD) in the Republic of Cyprus – i.e. the southern part of the island which is under the government's control. The report was compiled by the author using publicly available information and data. The sources used are referenced at the end of the report.

1.2 Institutional Framework of the Water Sector

The institutional structure of the water sector in Cyprus is shown schematically **in Figure 53.** At the policy level, the lead ministry is the Ministry of Agriculture, Rural Development and Environment (MARDE), who is responsible for the formulation of water policies, which must be approved by the Council of Ministers. All decisions related to water policies in Cyprus—including tariff changes for domestic supply and irrigation, or annual allocations of water from dams and other sources—are made at the level of the Council of Ministers. This reflects the strategic importance of water management in a context of extreme water scarcity. At the executive level, responsibility is divided between MARDE and the Ministry of the Interior. Other important ministries are the Ministry of Finance (which approves budgets), the Ministry of Health and the Ministry of Commerce, Industry, and Tourism.

Figure 53. Institutional and Administrative Structure of the Water Sector



The Water Development Department (WDD) is the department inside MARDE in charge of the water sector and is responsible for both water policies and managing the large water infrastructure of the island (government-controlled areas). This includes (a) operation of dams, bulk water conveyance and treatment and public irrigation areas; and (b) the supervision of the desalination plants operated by private concessionaires.

The Ministry of the Interior supervises all local authorities (municipalities and villages administrations) through the district officers. As such, it directly oversees the various Water Supply and Sewerage (WSS) service providers, such as the water boards, sewerage boards, and local water municipal services.

1.3 Provision of Services

One key features of the development of WWTPs in Cyprus has been the widespread recourse to Public-Private Partnerships (PPPs) following the Design-Build-Operate (DBO) model. The large WWTPs developed over the last three decades, as well as most smaller plants in rural areas, have been done under the DBO approach. The strategic decision to rely on DBO schemes for the development of WWTPs in Cyprus was concomitant to the other strategic decisions to develop extensive wastewater treatment reuse for agriculture as another nonconventional water resource to complement desalination.

For the development of WWTPs, the DBO approach was deemed appropriate as it allowed for achieving a competitive cost of financing (the urban sewerage boards were able to borrow on favorable commercial terms) and made it easier to co-finance with EU grant funding. Still, private concessionaire had strong incentives to design and build the new plant efficiently (with no construction delays and no costs overruns) and carry out subsequent Operation and Maintenance (O&M) in a sustainable and efficient manner. The first DBO started operation in 1995 and the most recent in 2017.

Adopting the PPP approach for the development and O&M of the WWTPs has allowed to transfer operational risks to private concessionaires, who are liable for financial penalties in case the treated effluents do not meet minimum standards, as it was considered that the technological complexity of tertiary wastewater treatment justified adopting the PPP approach. Operating WWTPs with tertiary treatment levels entails complex technological processes, with significant risks of noncompliance with the more stringent effluent standards[31] required for agriculture (and subsequent risks in terms of public health). Under DBO schemes the financing of the new plants was provided by the public developer and off-taker[32]. Still, the private sector remained responsible for the design, construction, and subsequent O&M of the plants.

The first WWTP DBO in Cyprus started operation as early as 1990, and subsequently large WWTP DBOs for urban areas had been developed and are now in operation. The strategy of partnering with the private sector was also extended in parallel to the few older WWTPs in some rural areas, where O&M was delegated to private operators, sometimes in combination with civil works for rehabilitation under a “rehabilitate-operate-transfer” (ROT) approach. The DBO tenders were structured so that the private sector was left with the choice of treatment technologies – focusing only on required output parameters, that is, treatment capacity and effluent quality. This has resulted in a variety of wastewater technologies being operated now on the island, with tertiary treatment achieved with either sand filters or membranes bioreactors.

The development of the WWTP DBO market has led to a vibrant industry of private sewerage operators in Cyprus. This includes several joint ventures between Cypriot companies and other large European water companies – who operate the large urban WWTPs as well as some of the O&M contracts for smaller plants – as well as local companies who are active for both DBOs and O&M contracts in rural plants. This has ensured that there is solid competition for tenders on new DBO projects, as well as for the renewal of O&M contracts.

The contractual duration of WWTP DBOs has increased over time. The first contracts were awarded with O&M periods of either 5 or 10 years – reflecting an initial rather cautious approach regarding the delegation of O&M to private contractors, (keeping open the option of taking over the O&M of the plant after a few years). As the experiences with private O&M proved largely positive, at the end of the contracts all Sewage Boards decided to continue with private O&M, tendering new O&M contracts. The current policy for the new small

[31] Cyprus adopted water quality standards for wastewater reuse in 2005. Standards for agriculture reuse are: BOD5 10 mg/l, suspended solids 10 mg/l, faecal coliforms (Escherichia coli) 5 per 100 ml, and no eggs of intestinal worms. This compares with BOD5 25 mg/l and SS 125 mg/l for effluent as required under the UWWTD standards.

[32] Either the urban sewerage boards, the WDD, or for the new WWTPs in rural areas, the sewerage community boards.

WWTP DBOs to be developed under the UWWTD implementation program is to award longer 20-year DBO contracts including O&M – the rationale being that private O&M has shown its benefits and the rural Sewerage Boards will never have the technical capacity to take over the operation of the tertiary WWTPs during its useful life.

The O&M of the sewerage systems is the responsibility of each sewerage board. Following the construction and commissioning of the sewerage systems the sewerage boards are responsible for any customer connections subsequently made to the system. Every owner or occupant of a service location that is used for residential, occupational trading, business, employment for recreation or other purposes and is located in streets or areas that have a sewerage system in operation are informed that they are obliged to construct, at their own expense and according to the permit issued by the sewerage board, a private sewer that can be connected to the public sewer. Connection to the system is allowed only after the relevant written authorization from the sewerage board. The sewerage networks are operated and maintained by the sewerage boards without any noteworthy problems or issues.

1.4 Sewerage Services in Urban and Rural Areas

Cyprus is divided into 6 administrative districts as illustrated in **Figure 54.** Administratively, the urban areas are managed by municipalities, while in rural areas there are smaller administrations which are referred to as communities. Both municipalities and communities are local government authorities having jurisdiction over their respective administrative areas.

Figure 54. Map of Cyprus with Administrative Districts

Source: http://ontheworldmap.com/cyprus/cyprus-political-map.html)

The population in the Republic of Cyprus is 856,960 and the distribution of the population in the administrative districts based on the most recent census (2011) is shown in **Table 47**Table **31.** In addition to the permanent population, the island receives almost 3 million tourists per year.

According to the latest National Implementation Program (NIP-2016) there are 57 agglomerations, as shown in **Table 47**. Details of how the agglomerations were developed are described in the following sections.

Table 47. Population of Cyprus and Number of Agglomerations per Administrative District

District	Population[33] (2011 census)		No. Agglomerations[34]	
	Urban	**Rural**	**Urban**	**Rural**
Nicosia	244,500	89,620	1	12
Famagusta	17,693	29,645	2	6
Larnaca	85,874	59,491	1	12
Limassol	183,658	56,184	2	14
Paphos	63,542	26,753	1	6
Total	**595,267**	**261,693**	**7**	**50**

In urban areas sewerage services are mostly provided through urban sewerage boards, which serve the urban agglomerations in the main areas (Nicosia, Limassol, Larnaca, Paphos and the Famagusta resort area of Ayia Napa and Paralimni). These sewerage boards are organized as ring-fenced utilities with quasigovernmental status.

In rural areas sewerage services are provided by the community boards under the overall direction of the WDD. In order to optimize the number of waste water treatment plants (WWTP) in rural areas and to avoid the construction of a WWTP per agglomeration, where feasible, grouping of agglomerations was implemented.

The responsible authority for the implementation of the UWWTD is MARDE, primarily through the WDD which has the responsibility for the implementation of most of the UWWTD articles, and the department of Environment responsible for the articles relating to the monitoring of the performance of the WWTPs, the issuance of waste discharge permits and the review of the designated sensitive areas.

2. National Implementation Programs (NIPs)

The objective of the Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC is the creation of wastewater infrastructure for the proper collection, treatment and discharge of urban wastewater and the safe re-use of sludge, so as to protect the environment and the water bodies. The Republic of Cyprus reported and submitted to the European Commission (EC) its first National Implementation Program (NIP-2005) on March 8, 2005. The NIP-2005 reflected the baseline for the creation of wastewater infrastructure, being Article 3 (provision

[33] Statistical Service of the Republic of Cyprus. Demographic Report 2017.
[34] WDD. Report on Article 17 of the UWWTD. Cyprus Revised NIP-2008, December 2008.

of wastewater collection systems), Article 4 (provision of secondary wastewater treatment) and Article 5(2) (stringent treatment for wastewater discharged into sensitive areas).

In the NIP-2005, the transitional timeframe for the implementation of sewerage systems and wastewater treatment systems was December 31, 2012 for all agglomerations with more than 2,000 p.e. with 3 intermediate deadlines for 4 urban agglomerations with more than 15,000 p.e., as presented in **Table 48**. However, due to various challenges that are discussed in the subsequent section, these deadlines have not been fully met.

Table 48. Compliance Dates according to NIP-2005[35]

Agglomeration	Compliance Date
Limassol and Paralimni	31 December 2008
Nicosia	31 December 2009
Paphos	31 December 2011
All Agglomerations	31 December 2012

Based on feedback on the NIP-2005 from the European Commission and after the issuance of the EC Guidance Document in January 2007, Cyprus realized that the NIP-2005 had certain deficiencies which made its revision necessary, so as to reflect the terms, definitions and guidance data given in the Guidance Document.

Furthermore, since the compilation of NIP-2005, there were new technical solutions arising from design developments or political decisions by local authorities and revised government policies regarding organizational set-ups, which influenced the whole approach to the NIP.

Following the NIP-2008, revisions of the NIP followed in 2011, 2014 and the most up to date revised program publicly available is the NIP-2016, which was submitted to the European Commission in July 2018. In the NIP-2016 it is reported that there are still 34 agglomerations that are not yet in compliance with the Directive. The new expected compliance date reported is June 30, 2027.

2.1 Inventory of Agglomerations

The NIP-2005 was based on administrative entities and boundaries with an inventory of 42 agglomerations and using the official population census of 2001, as published by the Statistics Department, estimated a total generated load of 675.000 p.e. arising from permanent, seasonal and tourist population in agglomerations greater than 2 000 p.e. The agglomerations were divided in respective categories based on their p.e. load as well as their discharge area (normal or sensitive area), details of which are shown in **Table 49.**

In the NIP-2005 the agglomerations were:

[35] MANRE (now MARDE). Implementation of the UWWTD in Cyprus. Situation at time of accession to the EC (1.5.2004). August 2007

- 6 urban with a total of 545,000 p.e.
- 36 rural with total 130,000 p.e.

Table 49. Agglomerations based on the Size and Discharge Area in 2005[36]

Agglomeration Category	Normal Areas		Sensitive Areas		Total	
	no.	**p.e.**[37]	**no.**	**p.e.**	**no.**	**p.e.**
2,000-10,000 p.e.	31	102,900	4	16,100	35	119,000
10,000-15,000 p.e.	1	11,000	0	0	1	11,000
15,000-150,000 p.e.	2	137,000	3	218,000	5	355,000
More than 150,000 p.e.	1	190,000	0	0	1	190,000
Total	**35**	**440,900**	**7**	**234,100**	**42**	**675,000**
%	**83.3**	**65.3**	**16.7**	**34.7**	**100**	**100**

A reform of the inventory of the agglomerations was carried out in the revised NIP-2008 with a new methodology for calculating the size (generated load in p.e.) of the agglomerations, which was no longer based on past population data, but on future forecasted data. A safety factor was included in the size of the agglomerations to accommodate for possible future expansions of the agglomerations up to the end of their transitional period.

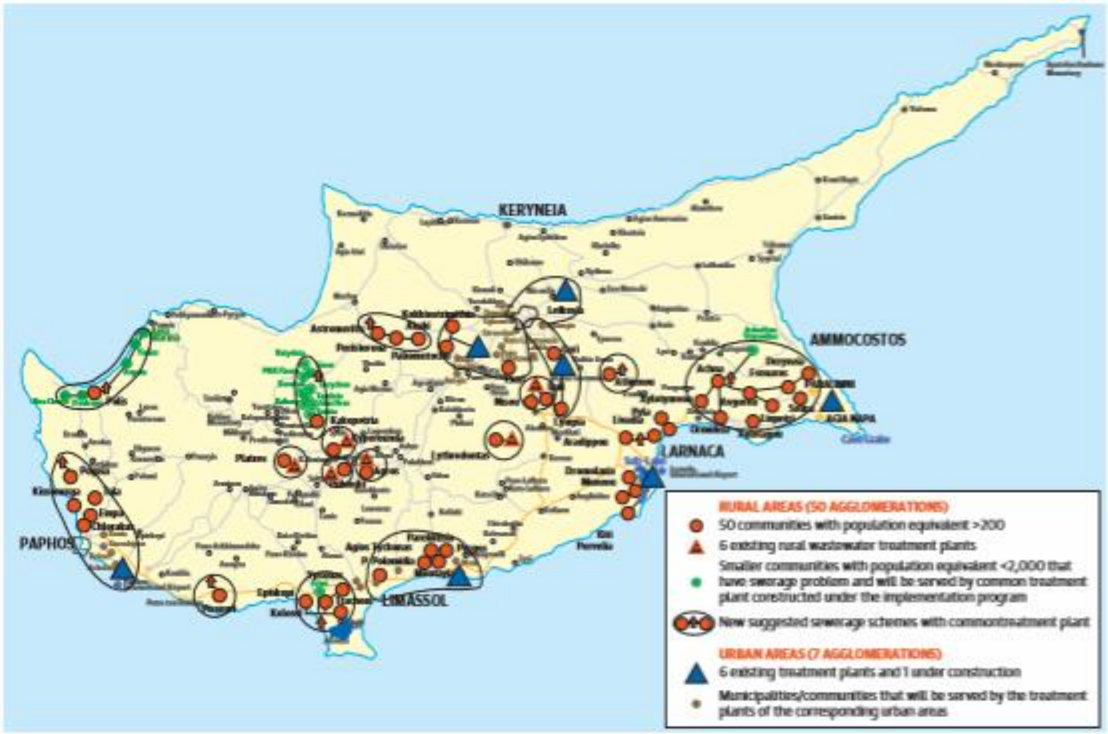
The NIP-2008 included 57 agglomerations with more than 2,000 p.e. and a total generated load of 860,000 p.e. The agglomerations (Figure **55** were:

- 7 urban with a total of 630,000 p.e.
- 50 rural with total 230,000 p.e.

[36] MANRE (now MARDE). Implementation of the UWWTD in Cyprus. Situation at time of accession to the EC (1.5.2004). August 2007

[37] In Cyprus, one PE is about 60 grams of BOD5/day, and the concentration of BOD5 is estimated at about 500 mg/litre

Figure 55. Map of National Implementation Program (NIP) 2008[38]



The latest program is the NIP-2016, which includes 57 agglomerations with more than 2,000 p.e. and a total generated load of 1,029,000 p.e. The number of agglomerations with a population of more than 2,000 p.e. remained the same as in NIP-2008. However, the p.e. load is higher than that of NIP-2008 to take into consideration the extended transitional timeframe for compliance, which is 2027.

The 57 agglomerations comprise:

- 7 urban with a total of 770,000 p.e.
- 50 rural with total 259,000 p.e.

Table 4 presents the number of agglomerations and total generated load based on the category of agglomeration and the discharge area (normal and sensitive).

Table 50. Agglomerations per Size and Discharge Area for NIP-2016[39]

Agglomeration Category	Normal Areas		Sensitive Areas		Total	
	no.	**p.e.**	**no.**	**p.e.**	**no.**	**p.e.**
2,000-10,000	46	202,300	0	0	46	202,300
10,000-15,000	3	36,700	0	0	3	36,700
15,000-150,000	5	325,000	1	65,000	6	390,000
More than 150,000	1	235,000	1	165,000	2	400,000

[38] MANRE (now MARDE). Report on Article 16 of the UWWTD for 2007 and 2008. August 2010
[39] MARDE. Report on Article 16 of the UWWTD for 2015 and 2016. August 2018

Total	**55**	**799,000**	**2**	**230,000**	**57**	**1,029,000**
%	**96**	**78**	**4**	**22**	**100**	**100**

Cyprus, over a period of approximately 11 years, from 2005 to 2016, had to revise the original implementation program based on the experience, information and data gained over time. There were 16 additional agglomerations from NIP-2005 to NIP-2016. Due to the new methodology for the delineation of agglomeration borders and the disaggregation of the urban agglomerations, new agglomerations were formed. Additionally, from the new method of calculating the size of agglomerations and the allowance of a safety factor for their future growth, new Rural agglomerations were also formed. A comparison between the original (NIP-2005) and the most recent available implementation program (NIP-2016) is presented in **Figure 56 and Figure 57** , the former figure relating to the number of agglomerations and the latter to the generated load.

Figure 56. Comparison of the Number of Agglomerations for NIP-2005 and NIP-2016

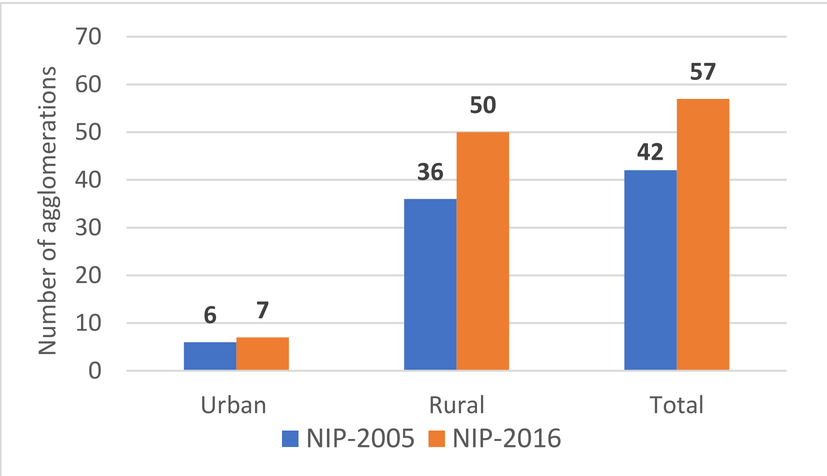


Figure 57. Generated Load comparison for Urban and Rural Agglomerations (NIP-2005 & NIP-2016)

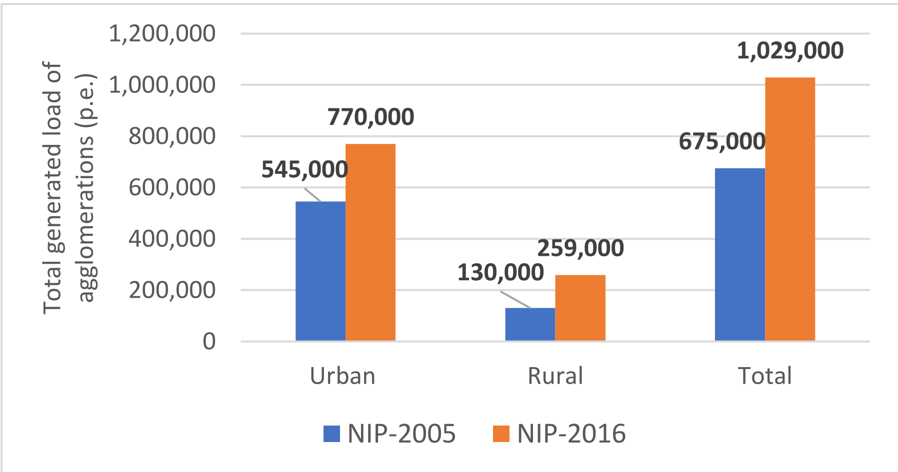
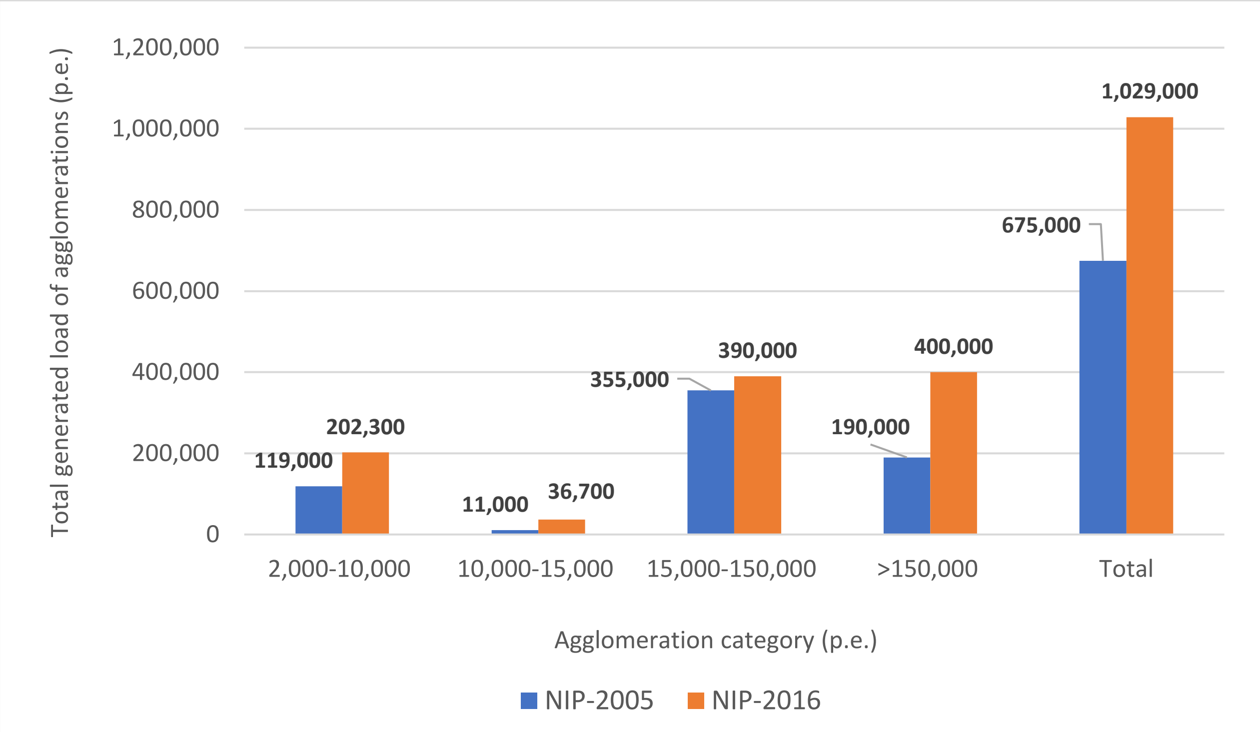


Figure 58 presents a comparison of the total generated load per agglomeration category for NIP-2005 and NIP-2016, where a marked increase in the p.e. load can be seen in all agglomeration categories, because of the reasons explained above.

Figure 58. Comparison of Total Generated Load per Agglomeration Category (NIP-2005 & NIP-2016)



According to the revised program (NIP-2016), 24 WWTP are expected to be constructed to serve the 57 agglomerations. Until the end of 2016, 17 WWTP were constructed with a total treatment capacity of 1,343,766 p.e. With the construction of the additional 7 WWTP the expected treatment capacity will reach 1,688,432 p.e. (Table 5).

Table 51. Number and Capacity of Waste Water Treatment Plants[40]

Agglomeration Category	No. of Treatment Plants as at 13.12.2016	Treatment Capacity (Total p.e.) as at 31.12.2016	Expected no. of Treatment Plants on completion of NIP-2016	Expected Treatment Capacity (Total p.e.) on Completion of NIP-2016
2,000-10,000 p.e.	8	37,717	12	176,116
10,000-15,000 p.e.	0	0	1	39,700
15,000-150,000 p.e.	5	433,265	7	599,832

[40] MARDE. Report on Article 16 of the UWWTD for 2015 and 2016. August 2018

More than 150,000 p.e.	4	872,784	4	872,784
Total	**17**	**1,343,766**	**24**	**1,688,432**

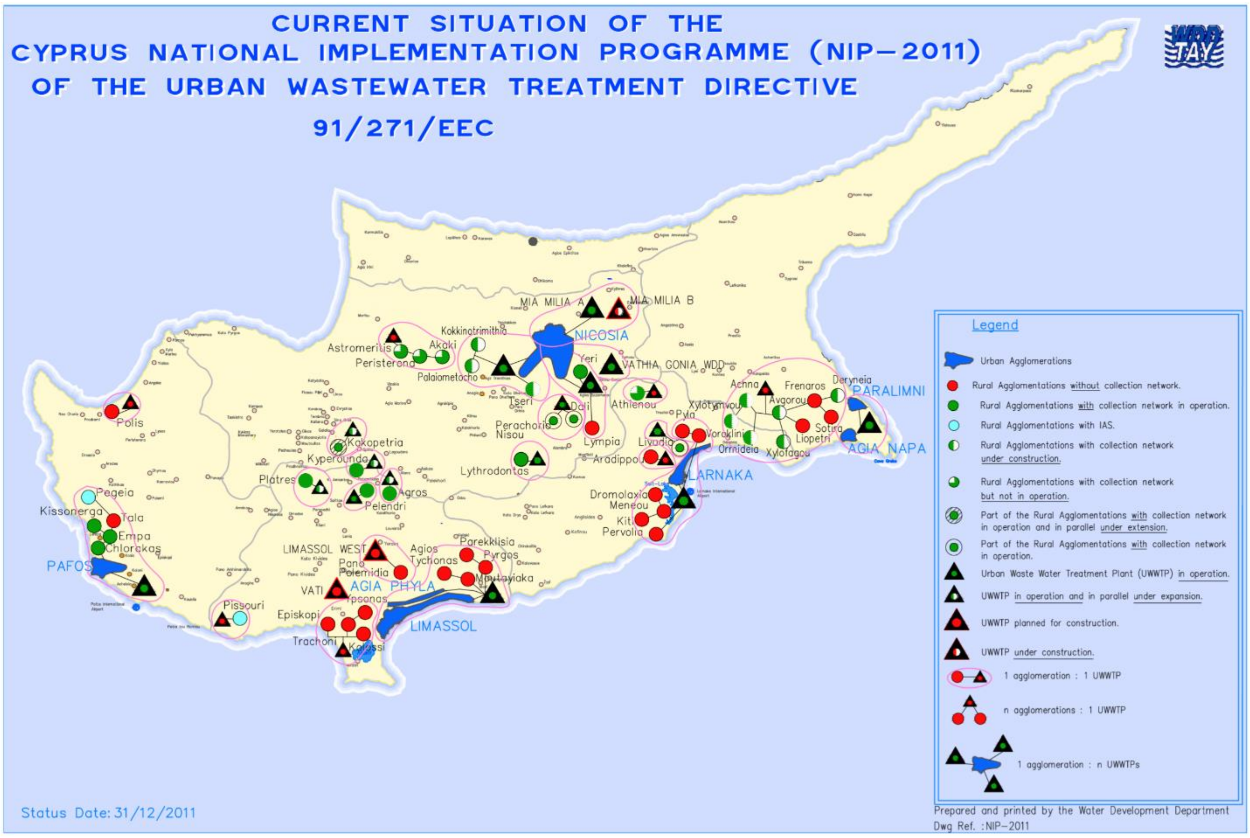
There are still 34 agglomerations (about 60 percent of total) that were not in compliance with the Directive at December 31, 2016. The expected progressive dates for compliance of these 34 agglomerations are presented in **Table 52** with the final compliance date June 30, 2027. The 34 agglomerations which were not in compliance in 2016 have a combined load of 249,000 p.e., which represents about 25 percent of the total load, indicating that these are the bulk of the smaller agglomerations.

Table 52. Expected Compliance Dates for Agglomerations not in Compliance at 2016

Agglomeration Categories	No. of Agglomerations not in Compliance	Expected Compliance Year							Total Load (p.e.)
		2018	**2019**	**2021**	**2022**	**2025**	**2026**	**2027**	
2,000-10,000 p.e.	29	3	2	9	4	6	1	4	127,300
10,000-15,000 p.e.	3					1	2		36,700
15,000-150,000 p.e.	2	1				1			85,000
	34	**4**	**2**	**9**	**4**	**8**	**3**	**4**	**249,000**

The current NIP map remains the same since its revision in 2011 (**Figure 59**) and shows information such as the geographical location of agglomerations and WWTP, Individual and other Appropriate Systems (IAS), etc.

Figure 59. Map of the National Implementation Program (NIP) 2016[41]



2.2 Individual Appropriate Systems (IAS)

Cyprus has complied fully with the requirements of the UWWTD with regards to the use of Individual Appropriate Systems (IAS). In such cases the same level of environmental protection as provided for the urban waste water discharged into the collecting system is achieved by either treating the wastewater locally or transporting it to a treatment plant.

There are 3 agglomerations with IAS in place, serving a total generated load of 14,000 p.e. These are located in the agglomerations of:

- Pegeia (7,000 p.e.),
- Tala (4,000 p.e.) and
- Pissouri (3,000 p.e.).

In all of the above systems it has been ensured that the urban waste water is contained and separated from the surrounding environment. Two types of IAS are currently used in Cyprus. One of this is the grouping of dwellings which discharge their effluent into watertight tanks. The owners of the dwellings are responsible for the construction of their tanks which are inspected and approved prior to be put into use. The tanks when full are emptied by the owners using private tankers which transport the waste water to WWTP authorized to accept effluent from tankers. Records are kept by the WWTP receiving the waste water for monitoring purposes. Checks are carried out by the local authorities to ensure that all tankers

[41] MARDE. Report on Article 16 of the UWWTD for 2015 and 2016. August 2018

discharge their effluent to designated WWTP and any Illegal dumping is reported to the Department of Environment.

In cases of isolated housing estates or hotel complexes, separate collection systems convey the waste water to small treatment plants located in the vicinity of each housing estate/hotel complex. These plants are operated by private companies and the treated effluent is used as recycled water for irrigation purposes. The Department of Environment carries out monitoring of the quality of the effluent and issues the licenses to discharge. In the case of the addition of new houses or housing complexes these are also connected to the plant and if needed upgrading works are carried out to increase the plant's capacity.

For the purposes of the Directive, the waste water addressed through IAS meets the treatment standards that are at least as high as those that apply to waste water delivered by a conventional collecting system.

Compliance with the requirements of the Directive is ensured through:

- having the same level of protection of the environment as is provided by collecting systems, and
- fulfilling the treatment requirements applicable to the agglomeration as a whole.

The registration and inspection of the IAS is carried out by the Department of Environment.

3. Organizational Set-Ups for Ensuring Directive Compliance

The Cyprus government, recognizing that many authorities are involved in the legal, procedural and administrative sides for implementing the UWWTD, and thus good co-ordination would be required between them, appointed a ¨Project Ministerial Committee (PMC)¨ in early 2007 for monitoring the progress and compliance with the Directive. The terms of reference of the PMC include the policy making, as well as the procedural and administrative problem solving.

A ¨Project Co-ordination Committee (PCC)¨ has also been established by MARDE, for coordinating and promoting the implementation of the Directive. The PCC reports to the PMC by means of regular reports and meetings where necessary. The WDD has been appointed as the chair of the PCC.

´Compliance´ of sewerage networks and treatment plants, with the requirements of the UWWTD is achieved provided:

a) a collecting system complies when it is connected to a UWWT plant
b) an agglomeration has more than 80-85% of its nominal load collected and treated

Disposal of Treated Wastewater and Sludge

4.1. Licensing

Licenses for the disposal of treated wastewater and sludge are issued by the MARDE for the wastewater treatment plants as well as the management of treated wastewater and are renewed every 4 years.

The licensing for disposal has stringent terms and conditions and stipulates explicit terms which include, inter-alia:

- Treatment requirements
- Quality parameters of the treated effluent
- The quantity and means of disposal of the treated effluent
- The areas and plants that could be irrigated with the treated effluent
- The requirements for normal and emergency storage reservoirs for the treated effluent
- The monitoring of the quality parameters and quantity of the treated effluent as well as of any treatment by-products and relevant record keeping
- The monitoring of the quality of the surface and underground water as well as of the soil at the areas of disposal in order to identify probable environmental impacts
- Submission of annual reports

Monitoring of the disposal of treated wastewater is carried out by the Department of Environment of the MARDE. Certain parameters relating to the quality of treated wastewater are measured as well as the quantity and quality of disposed sludge. Additionally, the quality of receiving water bodies and land at the disposal points is also monitored.

4.2 Treated Wastewater Reuse

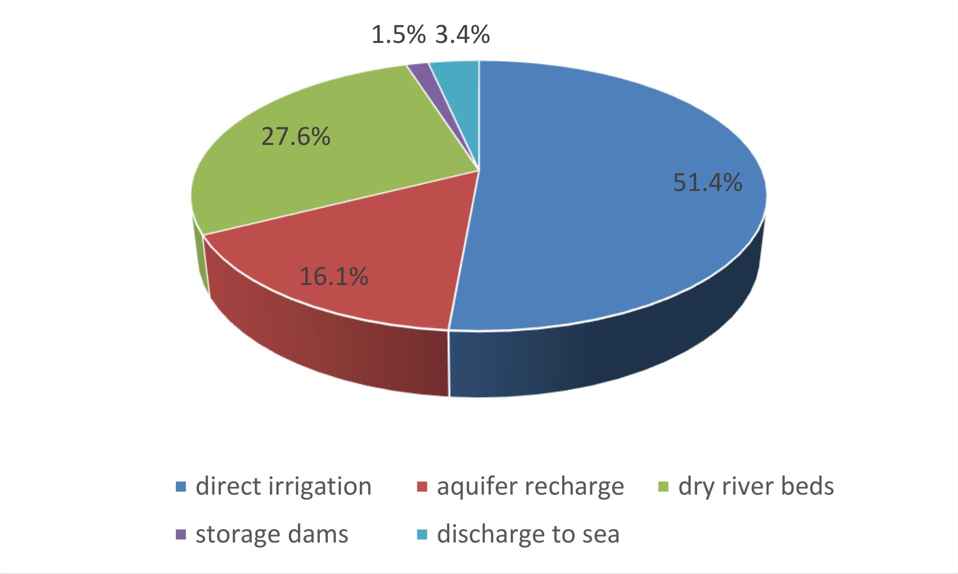
In Cyprus, treated wastewater is an important water resource. The WWTPs are equipped with tertiary treatment, consisting of sand filtration and chlorination in order to achieve higher quality characteristics to use the treated wastewater in agriculture. Some of the recent plants are equipped with advanced technologies, such as membranes, bioreactors and UV Disinfection. Conventional treatment technologies are used for the sludge treatment which is subsequently used for a number of purposes as described in the section below.

The treated wastewater produced from the WWTPs serving agglomerations with higher than 2.000 p.e., according to 2016 data[42] was used as shown in **Figure 60** below:

Discharge of treated effluent into the sea may be carried out during the winter period when the demand for irrigation is limited.

[42] IMPEL. Report Urban Water Reuse – Integrated Water Approach and Urban Water Reuse Project, July 2018

Figure 60. Use of Treated Wastewater



The treated effluent is mainly used for irrigation and it is suitable for a variety of crops, such as animal feed, olive trees, citrus trees, green areas, etc. Its use is not allowed for irrigation of leafy vegetables, strawberries, potatoes, beetroots, etc. The quality requirements for treated waste water used for irrigation usually depends on the type of discharge, the quality of the relevant water body, the crops irrigated, the sensitivity of the area and the size of the WWTPs.

An independent monitoring program for effluent quality from WWTPs started in 2007. The State Laboratory of the Republic of Cyprus carries out monitoring of the effluent discharged from the urban wastewater treatment plants. The parameters that are monitored, as per the requirements are BOD, COD as well as TN and TP for the WWTPs discharging into a sensitive area. The results from the monitoring program for 2016 showed that all WWTPs monitored are in compliance with the Directive.

4.3 Sludge disposal

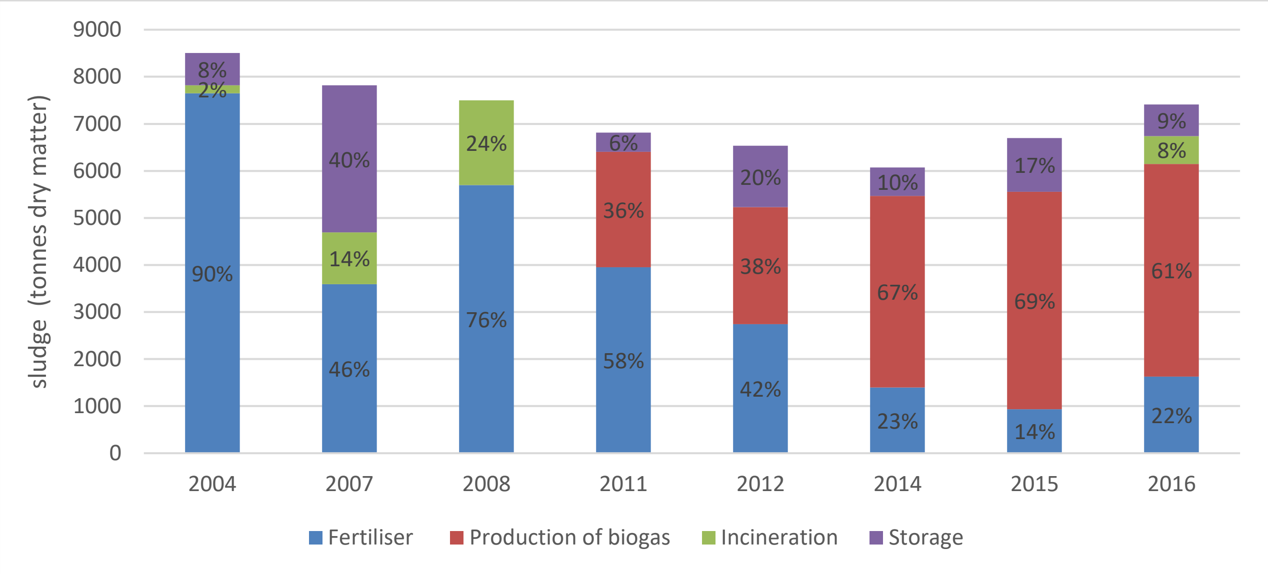
In Cyprus, the use of sludge from wastewater treatment plants for agriculture purposes is regulated by Water Pollution Control Laws and the Code of Good Agriculture Practice Decree. Apart from the requirements set in EC Directive 86/278/EEC, the Pollution Control Law requires the Licensing of the WWTP. The permit includes terms related to the sludge management including its use in agriculture.

Furthermore, the Code of Good Agriculture Practice includes the following additional requirements:

a) Prohibition of using the sludge in areas where the quality of surface waters or groundwater might deteriorate and on grassland for period of 12 months before utilization,
b) Guidelines on sludge storage, and
c) Factors to be considered for determining the quantity of sludge to be applied.

The sludge is used as fertilizer in agriculture, incineration in power stations for energy production and biogas production. **Figure 61** shows the production of dry matter from sewage sludge and where it was used.

Figure 61. Production and Use of Sludge[43]



4.4 Industrial Waste Water

Cyprus has in place and fully implements a waste discharge licensing system. Wastewater Discharge Permits are issued by the MARDE according to the provisions of the Water Pollution Control Laws.

The legal obligation under this Law is for owners/ managers of installations that require discharge to water or soil bodies to obtain a permit. The licensing procedure includes the submission by owners/ managers of installations of a comprehensive and detailed application for a Waste Discharge Permit.

Food industries come under the Directive's Article 13 for industrial waste water and include brewery and slaughterhouses which are compliant with the Directive. Their wastewater is not treated in central urban WWTPs, but they have their own WWTP with most cases having tertiary treatment in place. In all cases the treated effluent is used for irrigation (plants, olive trees, green areas around the industrial plants, etc.).

4.5 Agglomerations with less than 2.000 p.e. – long term planning

Although not a requirement of the Directive, the government has a long-term plan to provide networks and appropriate systems to all small rural communities with a population below 2 000 p.e., for upgrading their existing individual sanitary facilities (septic tanks and absorption pits). Pe-feasibility studies are being carried out with the aim to:

[43] MANRE (now MARDE). Implementation of the UWWTD in Cyprus. Situation at time of accession to the EC (1.5.2004). August 2007
MANRE (now MARDE). Report on Article 16 of the UWWTD for 2007 and 2008. August 2010.
MARDE. Report on Article 16 of the UWWTD for 2011 and 2012. July 2015.
MARDE. Report on Article 16 of the UWWTD for 2014 and 2015.
MARDE. Report on Article 16 of the UWWTD for 2015 and 2016. August 2018.

a) investigate the extent and seriousness of the sewerage problems per community
b) examine the need for centralized sewerage collection and treatment systems or propose other technical solutions, such as individual appropriate systems, taking into consideration, geological, environmental, financial aspects, as well as recent governmental policies for the merging of infrastructure between neighboring communities
c) prepare a well prioritized long-term plan taking into consideration the most critical aspects of finance.

Over and above the investment cost for compliance with the UWWTD's requirements, it is estimated that an additional investment of approximately 120 million Euros will be required for the communities with p.e. of less than 2 000.

4.6 Investments needed and Financing Plans

The financing and execution mechanisms for sewerage investments differ depending on the size of the agglomerations. In the urban agglomerations, the urban sewerage boards are financing, constructing, and operating the sewerage infrastructure. Financing for infrastructure investments is carried out through borrowing from the European Investment Bank (EIB) or commercial banks, to be repaid through the sewerage charges (both volumetric charges through the water bill, and the annual sewerage tax based on real estate value), with only the cost of tertiary wastewater treatment being subsidized by the central government. In the rural communities, the government is normally financing the construction with some grants from the EU cohesion funds which overall were less than 10 percent of the capital investments needed for the UWWTD.

Although sewerage investments largely came to a halt in 2013 with the Cyprus financial crisis and ensuing budgetary restrictions, most of the UWWTD objectives for the urban areas have been achieved. In the areas served by the five urban sewerage boards, the rate of coverage for sewerage collection services now stands at 84 percent—corresponding to a population of 645,000 being connected to sewerage networks. This represents a total length of about 2,800 km of sewer networks. It is estimated that an additional 270 km (less than 10 percent) would be needed to achieve full coverage based on targets set for compliance with the UWWTD.

Cyprus has proposed to the EC the updated UWWTD program (NIP-2016) with final compliance deadline set for 2027, taking into consideration inter alia the continuing budgetary constraints, and the special challenges of expanding sewerage systems in rural areas. This revised program aims to optimize the cost of UWWTD compliance, including consideration on individual appropriate systems (IAS) for rural areas where sewerage networks may not be the most economical solution.

4.7 Infrastructure financing

Cyprus realized that the UWWTD, with its requirements for creating wastewater infrastructure, is one of the most expensive European Directives and hence subsidizes partly the wastewater infrastructure in the areas of low affordability. Therefore, the government's subsidy policy differs for rural and for urban areas.

In the rural areas, which are considered low affordability areas, the government substantially subsidizes the wastewater sewerage infrastructure. The subsidy can be up to 80% of the capital investment for the required sewerage network, WWTP, treated effluent storage lagoon and central irrigation network. The rest of the funds are secured by the rural Sewerage Boards through loans from private financial institutions. The loan for the construction is normally obtained by the rural Sewerage Board from private financial institutions and is divided into two parts, Part A is the contribution of the community with the government being the guarantor and Part B is the government's subsidy, paid back directly to the financial institutions by the government. The government carries out economic analysis so that cost recovery can be achieved by imposing appropriate sewer tariffs.

Although urban areas, are not considered low affordability areas, the government subsidized the capital investment of the tertiary treatment of the wastewater treatment facilities and re-use schemes only, with the provision that the government capitalizes on the re-used treated effluent, as a natural resource. The finance is undertaken by the respective Urban Sewerage Boards. Securing the finance for the wastewater infrastructure, according to the Sewerage Systems Law, lies with the respective Sewerage Board. In the urban areas, the borrower for the whole loan, is the respective Urban Sewerage Board and the government pays back to this Board its contribution for the subsidy which corresponds to the tertiary treatment of the wastewater treatment facilities and re-use schemes. The Urban Sewerage Boards have until today secured the finance for the infrastructure of the urban agglomerations, partially from the EIB or the Council of Europe Development Bank and local banks.

4.8 Investments needed

The total investment for sewerage systems to meet the Directive's requirements was estimated at 1,430 million euros. As only 125 million euros was earmarked from EU grants, UWWTD compliance represented a big financial commitment for a country like Cyprus. Over and above the above investment cost for compliance with the UWWTD's requirements, it is estimated that an additional investment of approximately 120 Million Euros will be required for the communities with p.e. of less than 2.000.

Cyprus commenced its investments in meeting the UWWTD requirements from the pre-accession period. The investments made until the accession date, May 1, 2004, reached a total of €409 million, mainly in urban areas (€398 million) and very limited in the rural areas (€12 million). In the first National Implementation Program (NIP-2005), which set Cyprus's road to full compliance with the UWWTD by December 31, 2012 (interim date for compliance) according to the EU accession treaty, further investments were planned in amount of €565 million, bringing the total investment (past and forecasted) to €973 million.

Table 53. Investments (in Million €) Past and Forecasted for Agglomerations based on respective NIPs

Agglomeration Type	NIP-2005[44]		NIP-2008[45]		NIP-2016[46]	
	Spent until 01-05-2004	**Forecasted to be spent until 31-12-2012**	**Spent until 30-06-2008**	**Forecasted to be spent until 31-12-2012**	**Spent until 30-06-2016**	**Forecasted to be spent until 30-06-2027**
Urban	398	330	457	286	640	105
Rural	11	235	22	583	43	642
Total	**409**	**565**	**479**	**869**	**683**	**747**

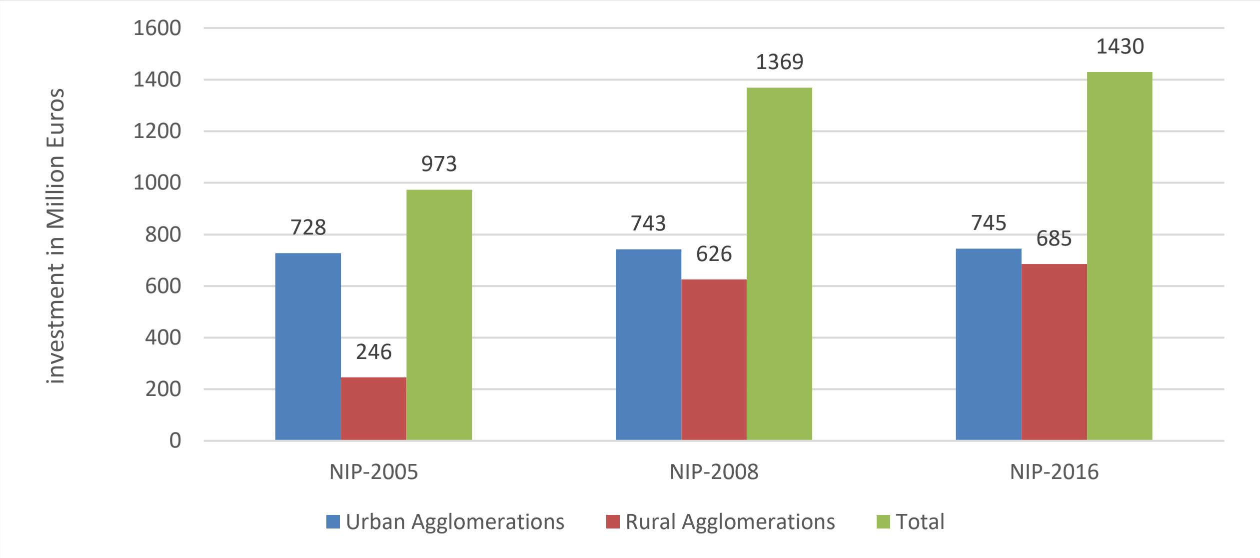
However, as it can be seen from Table 53, the investments made from May 1, 2004 to June 30, 2008 were not at all significant (€59 million for urban agglomerations and €11 million for rural agglomerations). This was mainly attributed to the difficulties in securing the required finance, time consuming procurement procedures, etc.

In the NIP-2008 there was a marked increase in the investments needed to meet the Directive's requirements. A revision of the inventory of the agglomerations carried out with a new methodology for calculating the size of the agglomerations (generated load in p.e.), showed that the number of agglomerations and the corresponding total generated load increased, thus requiring an increase in the forecasted expenditure to meet the interim date for compliance of December 31, 2012. The revised forecasted investments were estimated at €869 million and considering that €479 million was already invested until June 30, 2008 (Table 7) the revised total investment increased to €1360 million. Until June 30, 2016, a total amount estimated to about €683 million was invested in the wastewater infrastructure, urban and rural, under the provisions of the Directive. The financial crisis which crippled the Cyprus economy during the period 2010 to 2016 had a detrimental effect in the overall investment program; during 2008 – 2016, only about €204 million have been spent, meaning less than a quarter of the forecasted amount of €869 million.

It is expected that for the complete implementation of the NIP-2016 by June 30, 2027, the additional amount to be spent will be approximately €747[47] million. The works that are planned between 2016 and 2027 relate to existing noncompliant agglomerations or agglomerations which have passed the deadline (2014). Projects include 25 collecting systems and 7 urban waste water treatment plants, with about 70% of this investment allocated to collecting systems. A graphical comparison of the total investments (past and forecasted) for compliance with Directive based on the respective NIPs is presented **in Figure 62**.

[44] WDD. Report on Article 17 of the UWWTD. Cyprus Revised NIP-2008, December 2008.
[45] WDD. Report on Article 17 of the UWWTD. Cyprus Revised NIP-2008, December 2008.
[46] Breakdown estimated (official data not yet published)
[47] 9th Technical assessment on UWWTD implementation – Annex V: National chapters, Final version May 2017

Figure 62. Total Investments (Past and Forecasted) for compliance based on respective NIPs



The EU Cohesion Funds will be used to secure part of the above investment amounting to €61 million, which is 8% of the total investments required. A comparison between the current situation of investments in collecting systems and treatment plants (new and renewed) and the expected situation between 2016 and 2027 shows that investments are expected to increase hugely and to reach an average of €62.6 million per year, representing € 73.8 per inhabitant per year[48].

4.9 Compliance challenges

Since joining the EU in 2004, Cyprus made considerable efforts to comply with UWWTD. At that time, significant sanitation investment was still required to expand sewerage networks and wastewater treatment within the areas covered by the large urban agglomerations on the island. In addition, compliance with the UWWTD required Cyprus to make an unprecedented effort to provide sewerage services in rural areas, which were largely undeveloped, by developing sewerage infrastructure in a total of 50 agglomerations above 2 000 p.e. (only 6 already had sewerage systems) as well as several smaller villages.

Procedural, social (public acceptability), legal, organizational and administrative issues were factors which caused major delays in the commencement of the wastewater infrastructure construction. Nevertheless, the proper identification of agglomerations and correcting the original classification at a later stage, in the revised NIP-2008, created additional delays.

The critical factor for the implementation of the wastewater infrastructure (collection systems and treatment plants) was and still is the lack of financial resources to cover the construction costs. The delay in complying with the directive triggered financial consequences; thus, the fines to be paid for infringement diverted significant financial resources from the investment program and induced additional implementation delay.

[48] Source: Section 5.9, 9th Technical assessment on UWWTD implementation, Annex V: National chapters, Final version, May 2017

Delays in project tendering for the construction of wastewater infrastructure occurred because of the lengthy procurement procedures. Tendering, evaluation and contracting according to the EC procedures took much longer than originally planned or anticipated. Procedures such as publishing announcements, public presentations, receiving public opinions delayed the whole process of preparing final designs and execution plans. The need to secure public acceptance and agreement regarding the location of the treatment plants contributed to the implementation delays. Although the design for many treatment plants had been completed the most difficult task was the identification of a broadly acceptable location for them.

Procedural and administrative matters took longer than anticipated such as discussions with municipalities and communities on connecting to existing systems and to avoid creating a treatment system per agglomeration or getting administrations to agree to merge, smaller urban centers to join larger urban centers.

The Hungarian Water Supply and Sanitation Sector and the Urban Waste Water Treatment Directive implementation

1. Introduction

96 percent of the surface water of Hungary comes from outside the country. It means that the country's exposure to external contaminations and pollution is extremely high and the quality and quantity of the water resources depend on water related activities of upstream riparian. Another great risk regarding the pollution of the country's water resources is the industrial, agricultural and residential use of water. The treated urban wastewater is a great pressure on the environment, especially on surface waters.

Groundwater sources play a major role in Hungary's drinking water supply system since more than 95 percent of it is abstracted from groundwater sources, making the protection of groundwater resources a strategic obligation. The main pollutants of groundwater are: agricultural (pesticides) and communal wastewater. Other risks are the areas without proper infrastructure for sewage and wastewater treatment where individual solutions need to be applied and drought can also cause a pressure on groundwater.

2. The evolution of water and waste water services in Hungary

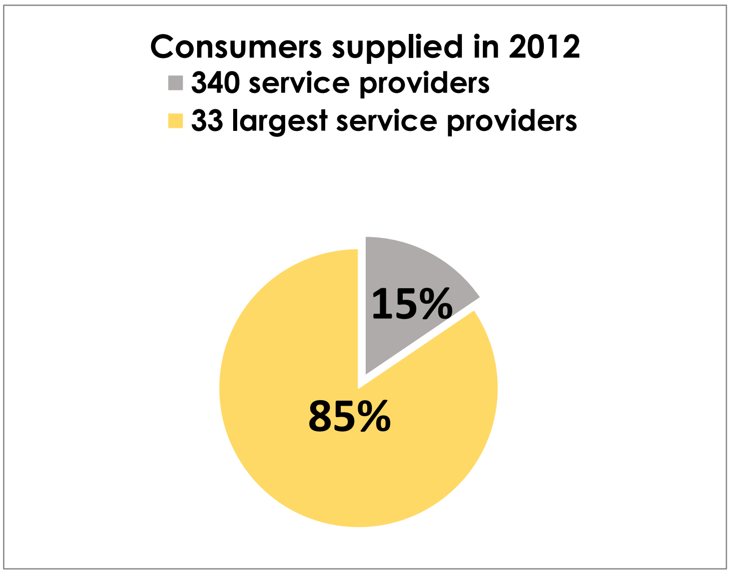
While drinking water systems and the infrastructure for supply has developed rapidly from the 1850's, wastewater collection systems had only been built in larger cities (mostly in county seats) before the Second World War. By 1948, 27 cities had adequate wastewater collection infrastructure resulting in a service coverage of 10 percent at the time. Despite central funds and financial assistance from the government, the development of urban waste water collection and treatment was trailing significantly behind many European countries by the 1990's. Service coverage of connected households was around 40 percent while half of the collected waste water was discharged into receiving waters without any form of treatment.[49]

When it comes to examining the Hungarian WSS sector, one can find that regulation in a longer period was constantly a subject of change. After the Second World War, in the communist era, the water utility market was highly fragmented with more than 400 service providers, mostly owned by local councils. The aim in the 1950's was to halt the fragmentation and introduce some form of rationalism by connecting the neighboring water utility systems. The solution was to form state-owned service providers by merger of the smaller ones. As a result of such rationalization the first aggregation process took place and, by 1962, there were only 34 service providers in the country. These companies were

[49] Information note of the Hungarian Government on the status of the National Implementation Program for the compliance of UWWTD.

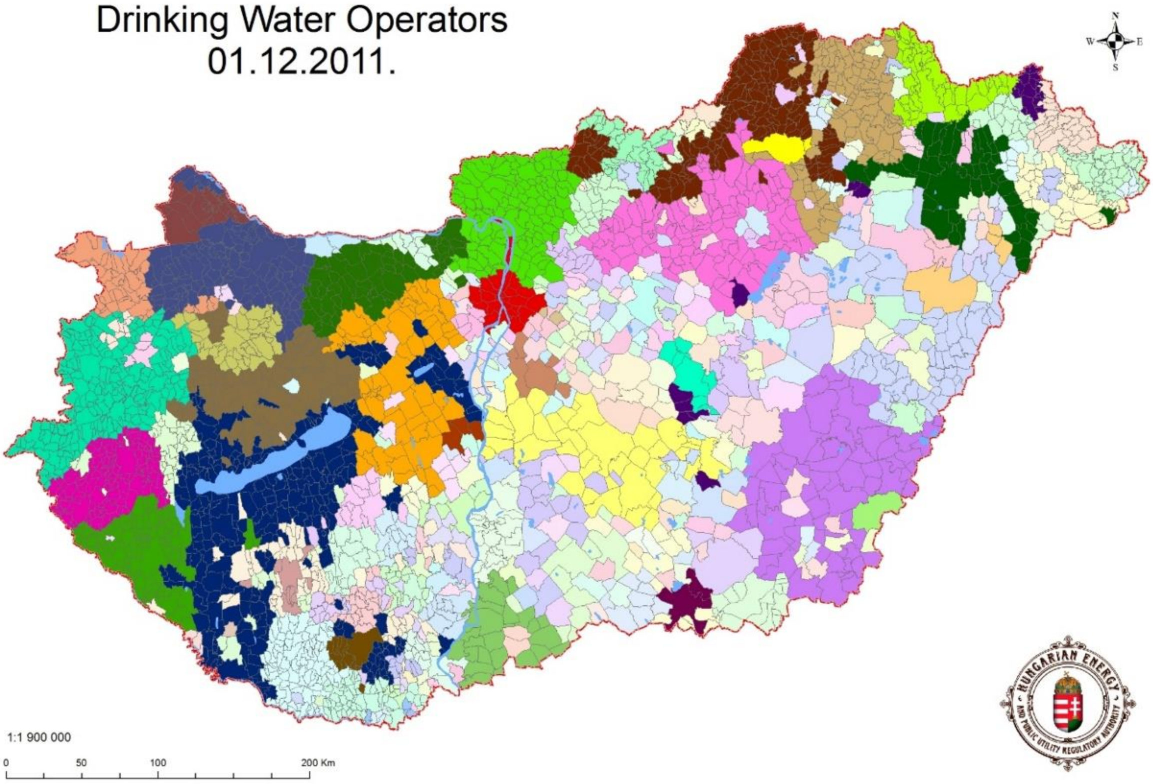
operating predominantly on a county level and in larger towns. It also meant that the level of service was improved as larger, better equipped service providers could operate efficiently and through higher qualified staff.

In 1989, the Hungarian Parliament amended the Constitution and – among other things – the sanctity of private ownership was declared. On the one hand, it was a great achievement; but on the other hand, it started such dynamism of privatization that lasted until mid-1990's. The accelerator of this was the Act XXXIII (Law) of 1991 which stipulated that the assets of state-owned companies were transferred into the ownership of local governments. The former companies that were operating on a county level broke-down into several smaller service provider companies. The 38 service providers existing in 1989 turned into over 400 ones by 2010, predominantly owned by local governments operating along different economic and financial background and contractual framework. However, in 2012, the 33 largest companies provided drinking water for 85% of the Hungarian population.



The 1990 Act on local governments set out that providing water and sanitation services is the task of local governments. After the change of regime, the ownership of the water utilities was transferred to local governments. However, not every local government got the ownership of the utility assets. The main reason behind it was that those regional pipeline networks which were originally owned by the state remained in state ownership, on the other hand, several connecting water utility systems couldn't have been operated separately from the regional network, and therefore the state ownership was still more adequate for these systems.

The above-mentioned reasons lead to the atomized water utility sector regarding the issues of ownership and the number of service providers. In addition, the issue of financing of the sector, tariff setting, and cost-recovery have been more than problematic. However, the most crucial problem was that the level of service of the nearly 400 small service providers was not satisfactory.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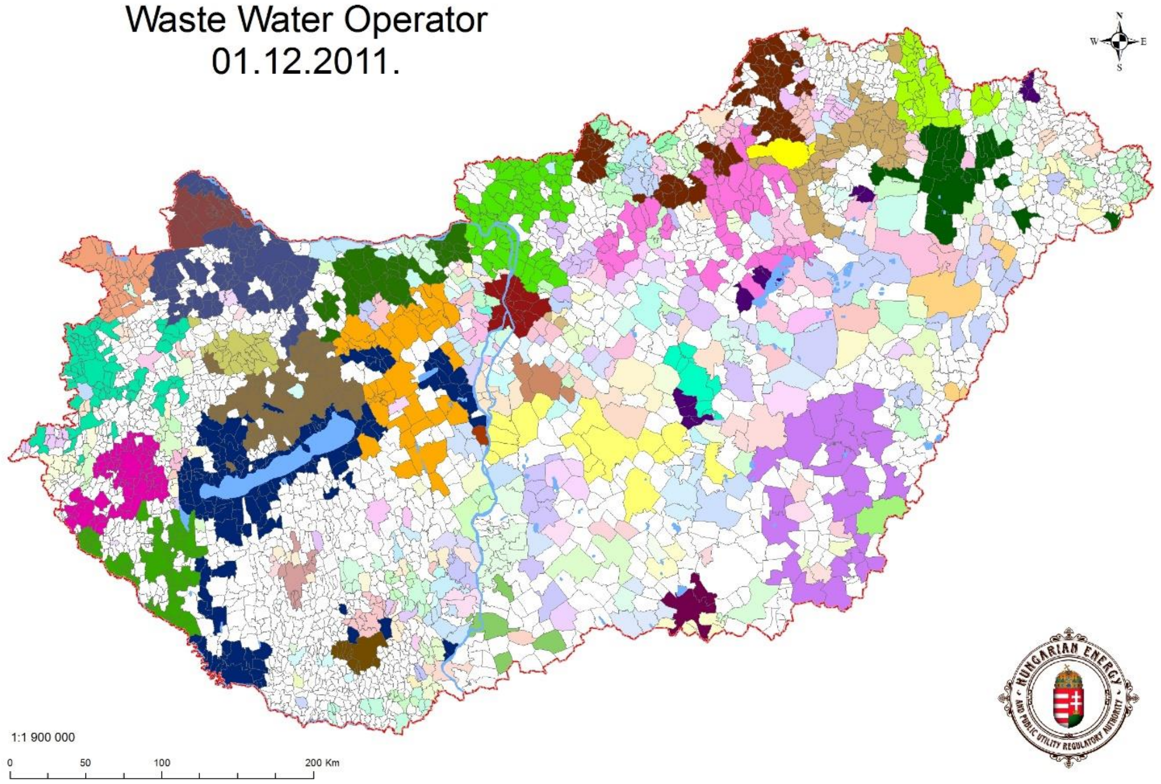
100
200 Km
HUNGARIAN ENERGY AND PUBLIC UTILITY REGULATORY AUTHORITY



Recognizing this trend, the Hungarian Parliament adopted Act CCIX of 2011 on Water Utility Services on 30 of December 2011; therefore, the water and sanitation sector has been regulated through a comprehensive law. It is important to emphasize that there has not been a separate law on water services ever before; the Act LVII of 1995 on Water Resource Management and other means of secondary legislation had regulated only the most basic rules on drinking water supply and sanitation services. The new act was the first step to redefine and make more transparent the fragmented water and sanitation market.

The main objectives of the Hungarian regulations are the following:

a) to protect national property and settle the ownership structure;
b) to establish the tariff setting process
c) market integration along the principle of regionalism, solidarity and the principle of the prohibition of cross-financing;
d) to establish data gathering on water utilities and set up a public registry;
e) to supervise water utility developments and reconstructions;
f) to establish professional supervision and control by conferring the necessary competencies to a national regulator.

According to the prior mentioned, the act vested the Hungarian Energy and Public Utility Regulatory Authority with the supervision of the water utility sector. Since 2013, the Authority is an independent, multi-sector regulatory authority by law which is only subject to law. It has a separate and independent budget and the only responsibility towards legislation is to give an annual report to the Parliament on its activities.

3. The Hungarian Energy and Public Utility Regulatory Authority

Since its establishment, the Hungarian Energy and Public Utility Regulatory Authority (hereinafter referred to as 'Authority') has become a regulator widely recognized throughout Europe and beyond its borders. The regulator was founded by the Act XXII of 2013, on the effective date of April 4, 2013, as an independent regulatory body. Its legal predecessor was the Hungarian Energy Office established by the Act XLI of 1994, as one of the first energy regulatory bodies in Europe - with the primary goal of regulating and supervising the electricity and natural gas markets.

The role of the Authority has been continuously changing along with the development of the market structures and the operating models as well as with the European legislation. Its main responsibilities are consumer protection, providing regulated access to networks and systems, carrying out regulatory competencies in order to maintain security of supply and fostering competition. Within the complex field of consumer protection its key task is – besides regulating the quality of supply – to keep end-user prices on an affordable level, especially under the circumstances of economic and financial crisis. The scope of the infrastructures, which have to be overseen by the Authority, has been extended in 2011 with the complete regulation of district heating and in 2012 with the water utilities and price regulation of waste services.

As it was mentioned above, the Authority is responsible for licensing, supervisory, price regulation and price and fee preparatory tasks related to electricity, natural gas, district heating and water utility supply and the preparation of the fee of the waste management public service. It performs tasks related to the integrated national energy statistics and discharges obligations of supplying data to national, international and other organizations as an official statistical agency. Since Act LVII of 2015 on Energy Efficiency has entered into force, the Authority also performs tasks related to the energy audit obligation, energy auditors, registration/cooperating organizations and specialist activities.

Water related competencies are set out in Act CCIX of 2011 on Water Utility Services. Since the introduction of this law, the Authority is entitled to supervise the water utility sector and has more than 40 administrative rights and competencies in the field of water utility supply.

The main powers of the regulator regarding WSS are the following:

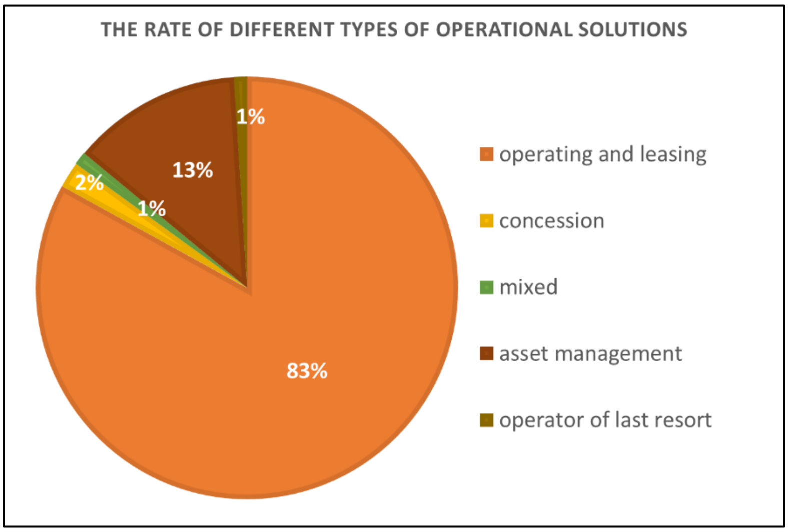
- Price supervision. The Authority is entitled to supervise, control and regulate the prices of water utility service.

- Submitting a proposal on prices (tariff setting). The Authority is entitled to submit a proposal on the utility tariffs each year to the minister responsible for water utility supply.
- Licensing. Supplying drinking water and managing wastewater can only be delivered, while an operator is in the possession of the license granted by the Authority. The Authority also has the right of granting the application of prices differing from the utility tariff.
- Approving powers. It is also the right of the Authority to approve the "rolling development plans" [long-term (15 years) development plans] which consist of development, replacement and investment design plans. The Authority also approves the operational agreements between the responsible entity and the service provider.
- Designation of the operator of last resort. The Authority - in the favor of public interest for service - can designate an operator of last resort to provide water services, in case the service is endangered and the local government or the state has not ensured to provide the necessary supply.
- Approving changes governed by company law. The consent of the Authority is required for the merger, division (transformation), reduction of the registered capital or equity capital by at least 25 % of the service provider.
- Monitoring. The Authority is entitled to control the service provider company's adherence to the granted license and the application of lawful prices. The Authority also supervises whether the operation of the service provider is adherent to the law.
- Other important responsibility of the Authority is the management of public registry of water utility systems, service providers, and responsible entities.

4. WSS sector reform in Hungary: aggregation of service providers

According to the Act on Water Utility Services, the property of water and waste water infrastructure can be owned only by the state or the local government. The act also defines that it is the right and the obligation of the state or the local government (the responsible entity) to provide public water utility service. To execute this task the state or the local government have to sign an operational agreement with a chosen service provider on water utility services. There are three kinds of operational agreements:

- asset management agreement,
- concession agreement, and
- operating and leasing agreement.



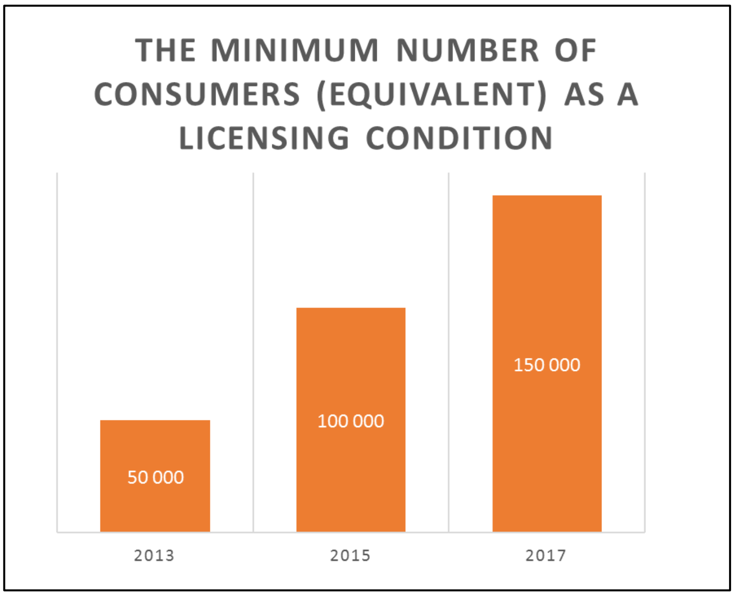
The act has another crucial rule on service provision: supplying drinking water and managing wastewater can only be conducted in the possession of an operational license granted by the regulator. When the Parliament set up the regulator, one of its primary tasks was to conduct the licensing process during 2013-2014 and oversee the requests for license of the service providers in order to ensure the long-term sustainable, high quality and efficient operations. Those business associations in the form of limited liability company and private limited company could receive an operational license which possess an operational agreement for the supply area and complied with the criteria determined by law. According to these criteria a high level of technical capacity is vital to get a license, and in addition, financial indicators and the qualification of the staff and management are also fall under thorough examination.

Regarding the operational licensing process, one of the main instruments of aggregation is the introduction of the **concept of 'consumer equivalent'**. One consumer equivalent equals to one household's access to drinking water and/or to wastewater. The regulator issued the operational license for the service provider, if the consumer equivalent reached 50 000, and the service provider fulfilled the conditions of the law. In case, the total consumer equivalent

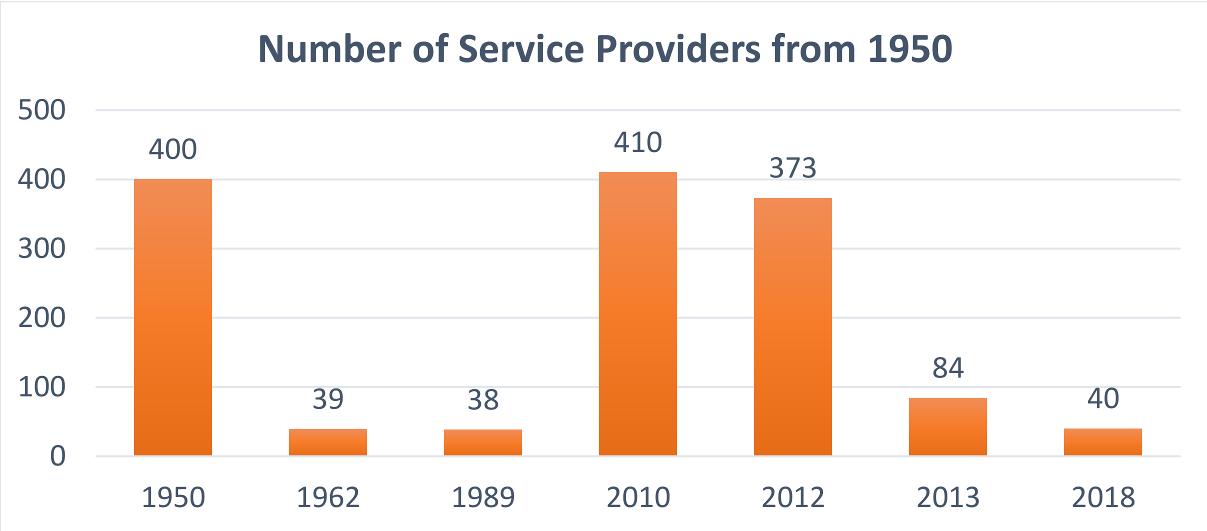
a) didn't not reach 100 000, by 31 December 2014,

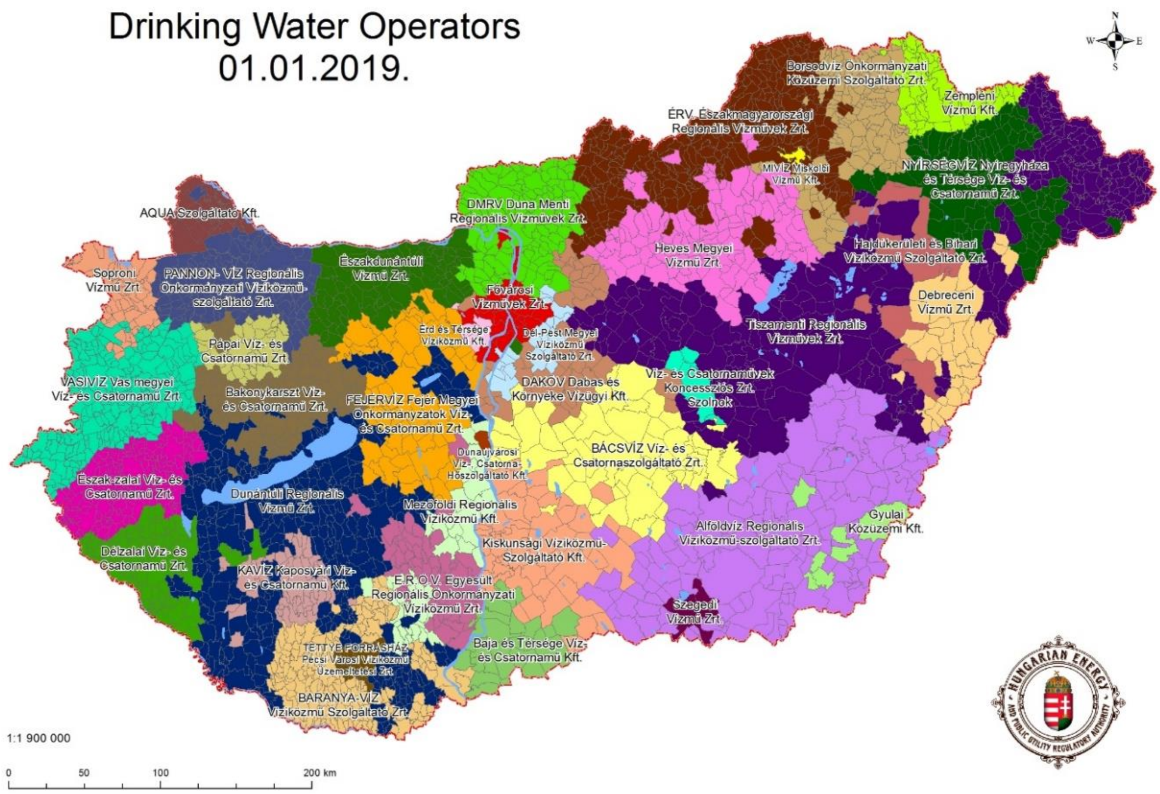
b) reached 100 000, but it is less than 150 000, by 31 December 2016

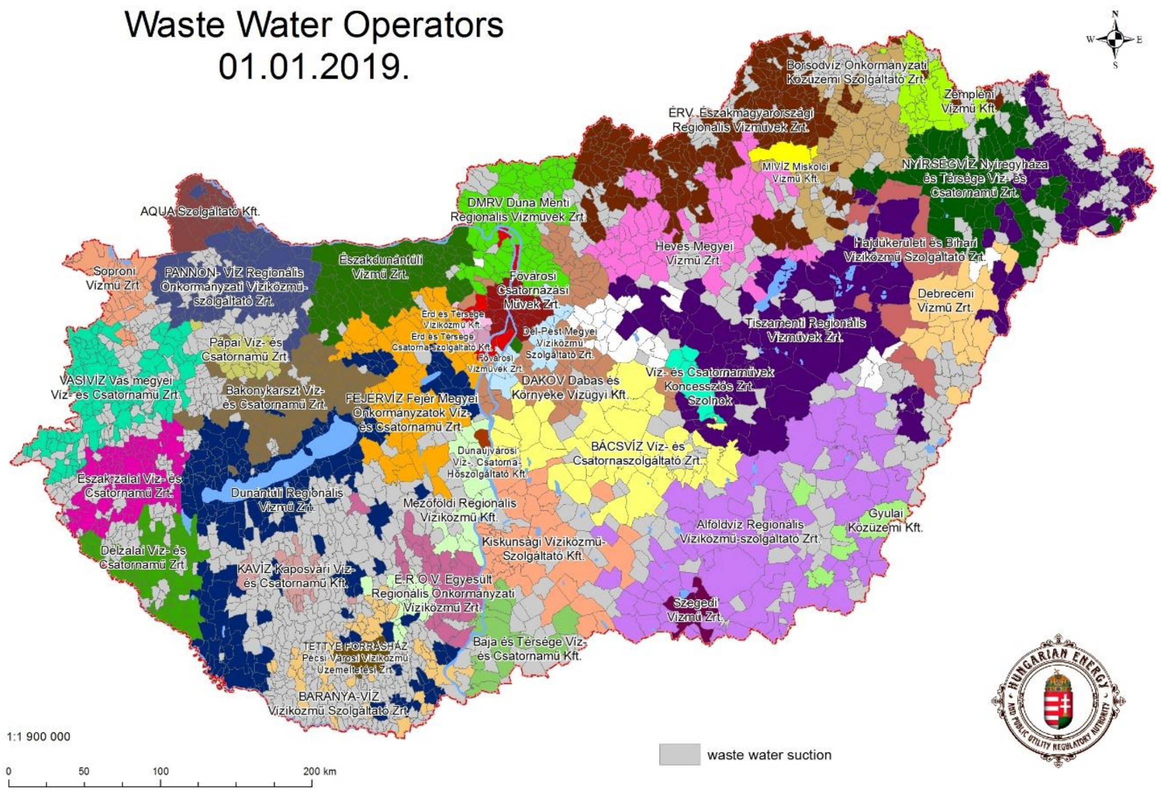
the operational agreement should have been withdrawn.



Until the deadline stipulated by law, 84 service providers submitted a request for operational license and as the result of the operational licensing process, the regulator has granted license to 47 service providers (45 multi-sector and 2 wastewater service providers). Due to mergers and termination of companies the total number of service provider companies in the country today is 40. As the result of aggregation, the number of service providers has been decreased and is to be continuously decreased, which generates a change of quality of supply, because the remaining service providers are going to operate along more transparent conditions.







5. Hungary's obligations regarding the Council Directive concerning urban waste water treatment (91/271/EEC)

The European Union regulates urban waste water treatment in 91/271/EEC Directive (hereinafter referred as to 'UWWTD'). The Directive determines the requirements for agglomerations with more than 2000 population equivalent (PE) for the collection, treatment and discharge of urban waste water and the treatment and discharge of waste water from certain industrial sectors. The gist of the obligations is that an adequate collecting system and treatment capacities have to be built out and operated.

The obligations are the same for every Member State, but **Hungary in the Accession Treaty got a temporary exemption for the implementation deadlines**.

Table 54: Implementation deadlines for requirements in the UWWTD

Type of agglomeration and sensitive areas	EU12	Hungary

Urban waste water discharging into receiving waters which are considered 'sensitive areas' for agglomerations of more than 10 000 p.e.	31 December 1998	31 December 2008
Collecting systems for urban waste water with more than 15 000 p.e.	31 December 2000	31 December 2010
Collecting systems for urban waste water between 2 000 and 15 000 p.e.	31 December 2005	31 December 2015
Urban waste water discharging into receiving waters which are considered 'sensitive areas' for agglomerations between 2 000 and 10 000 p.e.	31 December 2005	31 December 2015

6. The National Settlement Waste Water Discharge and Treatment Implementation Program

The UWWTD sets obligations for the Member States, but according to Hungarian regulations, the implementation of these tasks is in the competency of local governments. Act LVII of 1995 on Water Resource Management declares that **it is the public task of local governments to ensure urban waste water collection and treatment in the area of more than 2000 p.e.**[50]

The Act on Water Resource Management stipulates that local governments fulfil this task in the framework of agglomerations set out by the government in a national program. This program is called the **National Settlement Waste Water Discharge and Treatment Implementation Program.** The government updates the Program every two years and revises the boarders of agglomerations if necessary. The law also describes the conditions for defining agglomerations for waste water collection and treatment. The following factors should be taken into consideration when defining agglomerations:

- environmental, public health and epidemiological,
- natural and landscape conservation
- geographical
- climatic, hydrological and hydrogeological,
- economic (settlement pattern, settlement development),
- technical,
- operational,
- social,

[50] Article 4 (1) b) of Act LVII of 1995 on Water Resource Management

- touristic conditions.[51]

The methodology for defining agglomerations with more than 2 000 p.e. was first introduced in Hungary with the Governmental Decree 26/2002 (II.27.) on National Settlement Waste Water Discharge and Treatment Implementation Program and it was replaced by Governmental Decree 379/2015 (XII.8.) which came into force on 1 January 2016. **The methodology is presented in a separate document.**

Agglomeration class	Number of agglomerations	Proportion of agglomerations	Total load of waste water (thousand p.e.)	Total rate of waste water load (%)
Under 2000 p.e.	1173	67,7	696,9	5,6
2000-10 000 p.e.	368	21,3	1654,2	13,2
10 000-15 000 p.e.	61	3,5	727,1	5,8
15 000-150 000 p.e.	115	6,6	4234,6	33,9
150 000 p.e. -	15	0,9	5183,5	41,5
Total	1732	100	12496,3	100

7. Investment programs of the waste water sector in Hungary

It was already mentioned that waste water service coverage and infrastructure were lagging behind in development terms in the early 1990's in Hungary despite several funding options of the central government. Recognizing this drawback, an intensive support system was developed in 1993 using a designated and target support system. The first investment programs lasted until 2000 and a large amount of waste water systems were constructed and set into operation. The number of supplied settlements doubled from 14 percent in 1990 to 27,2 percent by 2000, with 70 percent of the total of their households connected to the waste water collection system.

a) Investment programs between 2002-2006

The local governments had several options for financing their waste water investments. Until 2004 the most commonly used forms were the designated and target support systems for

[51] Article 7/A of Act LVII of 1995 on Water Resource Management

priority projects where in most cases the government's financial support was 50-75 percent of investment costs.

The second most important investment program was the Environmental Fund which was later replaced by the Environmental and Water Target. Typically, the government financed 70-75 percent of investment projects and local governments had to bear the remaining costs. There were some cases, especially in disadvantaged regions where the government support even reached 100 percent.

The third type of financial supports was the regional development support for disadvantaged areas.

Support system	2003	2004	2005
Government + EU financial support (million EUR)	125,5	98,1	166,4
Percentage of support	76,4	80,6	73
Value of investment (million EUR)	164,2	121,7	228
Designated and target support	80,5	82,3	54,7
EU support	6,2	8,1	72,6
EU and Hungarian co-financing	4,7	8,8	34,3
Percentage of designated and target support in total financing	49	67,7	24
Percentage of EU support in total financing	3,8	6,7	31,9
Percentage of EU and Hungarian co-financing in total financing	6,7	14	46,9

b) Investment projects funded or co-funded by the EU (2002-2017)

In Hungary, the ISPA and Cohesion Fund financing was supplemented by government support as well, so the local governments needed to bear only 10 percent of investment costs. There was only one exception: the Budapest Central Wastewater Treatment Plant and related facilities project, where the capital city's government bore 15 percent of the investment costs.

	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**

Actual payments for waste water projects (million EUR)	1,04	15,9	77,9	160	331,8	433,5	384,3

The second financing solution was that the EU and Hungarian government co-financed projects utilizing the European Regional Development Fund by creating the so called Environmental and Infrastructural Operative Program (2002-2006). In these cases, the own contribution of local governments was only 5 percent.

The above-mentioned program was replaced by the Environment and Energy Operative Program (2007-2013) where Hungary provided for 15 percent government co-financing from which almost half concerned waste water investments. The average of the own contribution of local governments was 16,5 percent.

	2015	2016	2017
Actual payments for waste water projects (million EUR)	0,57	43,8	296,5

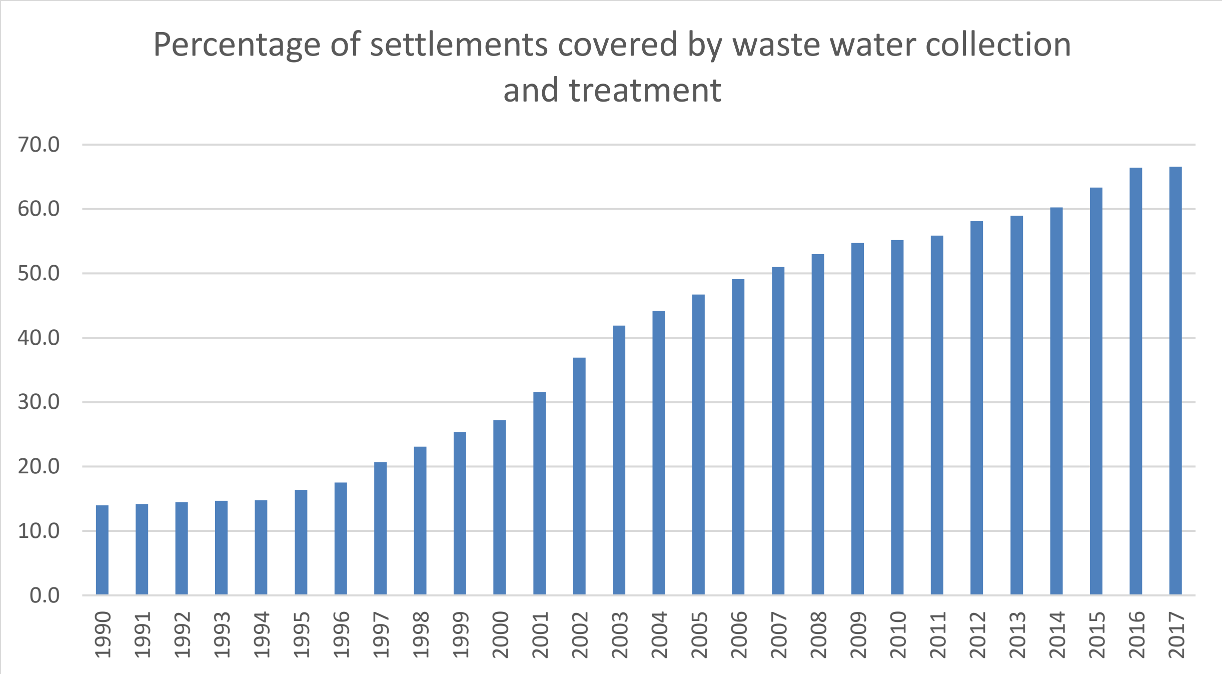
This program was also replaced in the next EU budgetary period (2014-2020) by the **Environment and Energy Efficiency Operative Program** with a similar approach.

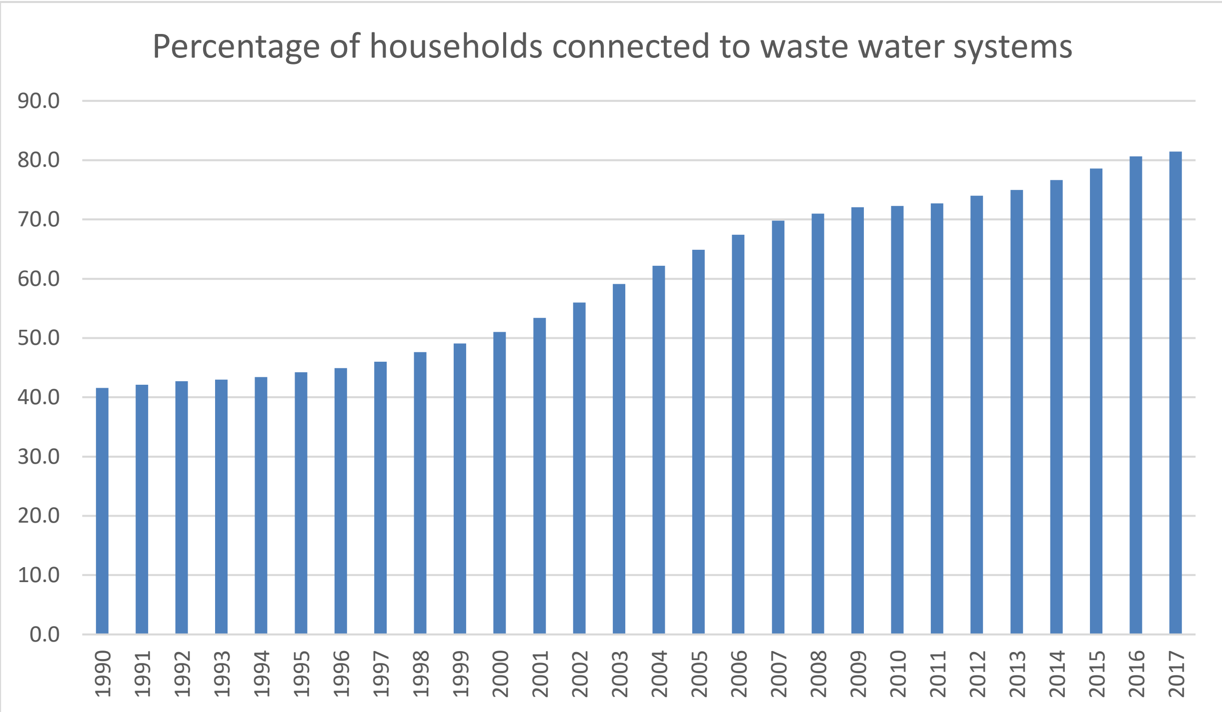
By 2013, 88% of the total of the households living in agglomerations above 2 000 p.e. were connected to the waste water collection system.

Table 55: Waste water collection in Hungarian settlements and households (1990–2017)

Year	Waste water collection						Length of waste water network (km)
	Settlements		Households				
	Number	Percentage of the total	Total	Percentage of the total			
				Country	City	Village	
1990	429	14,0	1 616 714	41,6	64,8	3,2	11 964
1991	437	14,2	1 648 703	42,1	65,3	3,4	12 524
1992	447	14,5	1 679 988	42,7	65,7	3,7	12 933

1993	456	14,7	1 701 977	43,0	65,8	3,9	13 815
1994	460	14,8	1 724 746	43,4	65,5	4,4	14 902
1995	514	16,4	1 761 471	44,2	66,1	5,6	15 683
1996	547	17,5	1 801 687	44,9	66,4	6,9	16 974
1997	647	20,7	1 855 322	46,0	66,9	8,5	18 472
1998	724	23,1	1 925 604	47,6	67,0	11,5	20 922
1999	794	25,4	1 992 516	49,1	68,1	14,0	22 732
2000	854	27,2	2 078 762	51,0	69,8	16,6	24 683
2001	992	31,6	2 179 085	53,4	69,9	20,2	27 233
2002	1156	36,9	2 299 383	56,0	72,2	23,2	30 536
2003	1302	41,9	2 298 888	59,1	74,7	27,4	33 268
2004	1392	44,2	2 595 470	62,2	76,9	31,9	35 447
2005	1469	46,7	2 733 853	64,9	79,0	34,7	36 863
2006	1545	49,1	2 856 674	67,4	81,1	36,7	38 744
2007	1607	51,0	2 979 885	69,8	83,2	39,7	40 530
2008	1669	53,0	3 054 956	71,0	84,0	41,1	41 897
2009	1725	54,7	3 119 437	72,0	84,7	42,3	42 438
2010	1741	55,2	3 144 228	72,3	84,7	43,2	43 200
2011	1763	55,9	3 169 234	72,7	84,7	43,4	41 786
2012	1833	58,1	3 258 172	74,0	85,0	46,7	42 958
2013	1860	59,0	3 305 776	75,0	88,0	50,2	43 524
2014	1900	60,2	3 383 559	76,6	86,8	50,2	44 699
2015	1998	63,3	3 472 513	78,6	88,0	54,0	47 819
2016	2095	66,4	3 571 061	80,7	89,0	58,7	49 851
2017	2100	66,6	3 616 694	81,5	89,8	59,7	50 244





8. Compliance issues with the UWWTD

Following the closure, on 7 December 2016, of the EU Pilot process that lasted two years, the Commission initiated infringement proceedings as it had considered that, on the basis of the information available, the requirements of the UWWTD were not met for 23 agglomerations in Hungary within the deadlines set in the Accession Treaty.

Referring to the case law of the Court of Justice of the European Union, the Commission emphasized that if an agglomeration does not have systems to collect all urban waste water produced by the agglomeration concerned, the obligation under the Directive to ensure that all collected urban waste water undergoes secondary or equivalent treatment cannot be a priori considered to be met.

In addition, as regards the use of individual or other appropriate systems, the Commission has concluded that the conditions set out in the Directive for the application of such systems have not been met, as the agglomerations concerned, in fact, use individual or other appropriate systems not because the establishment of collecting systems would not be justified or because it would produce no environmental benefit or because it would involve excessive cost, but because the number of connections to existing collection systems is low. The Commission considers that the applicable legal framework does not provide a guarantee that the individual or other appropriate systems used will provide the same level of environmental protection as the Directive requires.

8.1 Hungary's position

The reply to the formal notice was sent to the Commission on 21 April 2017. In this reply Hungary has shown that indeed the concerned agglomerations with one exception do not comply with the Directive. The main problem with the implementation of the Directive is the low connection rate to the established collecting network. The following reasons of this were identified during 2016: unused plots, uninhabited real properties, financing problems of socially disadvantaged people, special technical conditions. Hungary is working to improve the connection rate to the sewer network as a result of cooperation with notaries, district offices and water utility providers.

On 7 December 2017, the Commission sent a reasoned opinion on the case, to which we replied on 13 February 2018.

With regard to the objections raised by the Commission in its reasoned opinion, Hungary explained that the Ninth Report on the implementation status and the programs for implementation of the Council Directive 91/271/EEC concerning urban waste water treatment, which was published by the Commission on 14 December 2017 (hereinafter "the Commission report"), had shown that, according to the reference state of 31 December 2014, the rate of compliance with Article 3 of the Directive was 100%, the rate of compliance with Article 4 was 95%, and the rate of compliance with Article 5 was 92%. According to the report, compliance with Article 5 has improved. The report concludes that, overall, looking at the performance as a whole, the situation in Hungary has improved compared to the previous report.

According to the Hungarian government, the Hungarian legislation, in accordance with the Directive, adequately ensures the exceptional character of individual or other appropriate systems. Collecting systems are built, but there is still a problem with the lack of connections to these networks. Following the environmental package meeting held in Budapest on 28 April 2017, through the Hungarian Water Utility Association, government officials called attention of water utility service providers that, according to Section 55 of Act CCIX of 2011 on water public utility services, they should exercise their right to call upon and notify in order to promote connections.

Based on the legislative amendment that came into force on 25 July 2017 (Government Decree 379/2015. (XII. 8.) Korm.), data on the inspections will be available annually from November 2018. In parallel with the amendment, electronic data collection was implemented, which is done through the TS-Online information system.

8.2 Individual or other appropriate systems: the need of a municipality-specific list

The introduction of data reporting was necessitated by the demand expressed by the European Commission in the EU-Pilot No. 6523/14 launched in 2014 because of the implementation of the Directive in Hungary and, as a follow-up to it, the infringement proceedings No. 2016/2186. Government Decree No. 379/2015. (XII. 8.) Korm. on the Municipality-Specific List of records on waste water disposal and treatment situation and the Information List, and on the delimitation of waste water disposal agglomerations (hereinafter: the “Government Decree”) came into force as of 1 January 2016.

What data shall be reported?
Information on individual waste water treatment plants, individual septic tank facilities equipped with drainage fields, individual closed waste water storage reservoirs and investment data for the planned developments shall be collected in Hungary within the scope of data reporting in accordance with the Government Decree.

The TSONLINE system was set up in 2017 by the General Directorate of Water Management in order to fulfil the mandatory reporting obligation under the Government Decree. The first go-live operation of the system took place in 2018.
Pursuant to Section 4 of the Government Decree, data on waste water disposal and treatment:

- individual sewage treatment plants,
- septic tank facilities with drainage fields,
- individual closed waste water storage reservoirs and the sludge arising from waste water treatment relative to all municipalities in Hungary shall be recorded in the Municipality-Specific List.

Individual waste water treatment is the use of individual waste water treatment facilities for the treatment, final disposal and/or temporary collection and storage of urban waste water equivalent to a waste water load of at least 1 and at most 50 population equivalent.

Types of IAS

- **Individual waste water treatment plant**

  Individual waste water treatment plant is a water facility that performs non-utility and biological treatment of urban waste water through energy input. In simple words, a small plant performing treatment of waste water of 1 to 50 population equivalent through electrical energy input from which treated waste water is disposed or dehydrated. In the case of dehydration, where the volume is less than 500 m3/year and the criteria set out in Paragraph (2) of Article 24 of Government Decree No. 72/1996 (V. 22.) Korm. are met (e.g. the soil is suitable for drainage, the waste water disposal network has not yet been built, or the connection of the real property to the implemented public utility involves disproportionately high cost compared to the technical costs of implementation) a notary approval is required, otherwise a water authority permit is required.

- **Septic tank facility**

  Septic tank facility equipped with a drainage field is a water facility consisting of a septic tank and a drainage field for non-utility drainage and disposal of urban waste water that performs anaerobic degradation of pollutants without energy input. More generally: after the sedimentation, the waste water is drained from the septic tank through the drainage pipes to the underground drainage field, where waste water treatment processes occur, and no electricity is used.

- **Individual closed waste water storage reservoir**

Individual closed waste water storage reservoir is a public utility substitute consisting of one or more closed and watertight tanks and/or basins used for the periodic collection and storage of waste water. Storage tanks and other types of closed systems are considered to be adequate if they are watertight, have no overflow and waste water is collected and regularly delivered to a waste water treatment plant.

Other rules for IAS

Based on Government Decree No. 455/2013., in the case of water use at a real property, the real property owner, trustee or other user is required, at least once a year, to use public utility service for the collection of domestic waste water not collected by public utilities.

According to the Government Decree, the reporting of data shall be performed electronically. The notary shall be responsible for the compliance (effective from 1 January 2019). Data shall be reported electronically through the TSONLINE interface. If the real property has an inadequate closed wastewater storage reservoir, the notary can obtain information about this from public utility providers licensed to collect domestic waste water in the municipality which is not collected by public utilities. Based on Government Decree No. 455/2013. on the detailed rules of public utility service related to the collection of domestic waste water not collected by public utilities, the public service provider shall provide the local government with data broken down by real properties by 1 March of the year following the reference year. The knowledge of the soil load charge in the municipality provides assistance to the notaries in data reporting (Act LXXXIX of 2003 on environmental load charges: "the obligation to pay the soil load charge shall be borne by polluters who do not connect to the technically available public sewer and use the method of disposing waste water that requires the local water management authority's permit, including the use of an individual closed waste water storage reservoirs").

In addition, Government Decree No. 72/1996. on the implementation of authority powers in water management, the local government shall maintain the local official water management records. According to this, a permit of the notary of the local government in the municipality is required for the establishment, operation, maintenance and demolition of water facilities with the capacity not exceeding 500 m3/year designated exclusively for the treatment of domestic waste water and the dehydration of treated waste water.

The Greek approach for UWWTD compliance for priority C agglomerations

In 2018 DG REGIO of the EC assisted the Greek Authorities to advance on planning, design, project development and implementation of projects in priority C agglomerations (agglomerations between 2 000 and 15 000 p.e.). A study was developed with the main objectives being to identify the remaining needs on infrastructure (i.e. WWTPs and/or sewage collecting systems) for these small agglomerations and to estimate the preliminary costs for these needs.

The text below is a summary of the report prepared by EMVIS (a Greek company actively involved in the wider field of Water Resources Management, through design studies, advisory work and research), which was shared with the World Bank team with the kind assistance of Mr. Michel Sponar from DG ENV.

According to the report the UWWTD was incorporated to Greece national legal framework in 1997 (Ministerial Decree 4673/400/1997), with amendments in 1998, 1999 and 2002, related to the designation of sensitive areas according to article 5 of the Directive. In accordance with the UWWTD the Member States shall ensure that all agglomerations with a p.e. between 2 000 and 15 000 are provided with collecting systems for urban wastewater at the latest by 31 December 2005. This category of agglomerations is referred to as priority C agglomerations in Greece and includes: 1) agglomerations with p.e. between 2 000 and 10 000 discharging to fresh-water and estuaries with deadline for the construction of collecting systems and wastewater treatment 31 December 2005 and 2) agglomerations with p.e. between 10 000 and 15 000 for discharges to coastal waters with deadline for the construction of collecting systems and wastewater treatment on 31 December 2005.

Report points out that in line with Greek reporting data as at 31.12.2017, 468 such agglomerations were identified, from which 386 refer to agglomerations with p.e. between 2,000 and 15,000 discharging to normal areas and 100 with p.e. between 2,000 and 10,000 discharging to sensitive areas, with total generated load of approximately 2 million p.e."

The report explores the possibility that the load generated by an agglomeration changes with time. A change of the load can be due to a range of factors, including change (decrease or increase) of the population of the agglomeration, or change (decrease or increase) of the sufficiently concentrated area. When the generated load changes, it is possible that the requirements for collecting systems and/or treatment (Articles 3, 4, 5 and 7 of the Directive) drop below or exceed the thresholds in p.e. previously reported under the Directive.

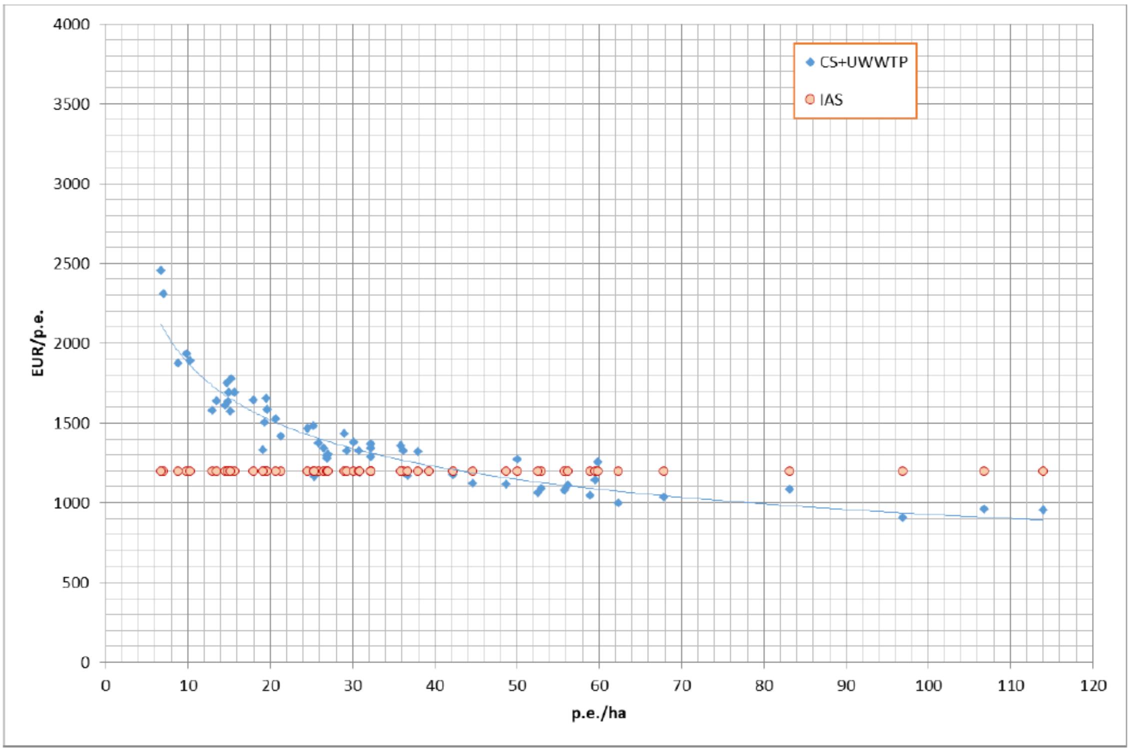
The study further develops this approach by developing a methodology for the identification of priority C agglomerations, which include reassessment of:

- Geographical/Administrative identification of communities;

- Estimation of generated load;
- Technical and economic criteria;
- Environmental criteria;
- Implementation procedures:
  - o Competent authority and timing for the identification of priority C agglomerations;
  - o Compliance time;
  - o Codification of agglomerations.

One of the main challenges in applying UWWTD is to define sufficiently concentrated areas, where collection systems are most efficient solution, excessive costs, and where implementation of IAS is justified. The report proposes that sufficiently concentrated area can be associated with an assessment of population density and, consequently, for every area with estimated generated load greater than 2 000 p.e. the respective population density is calculated. The study uses criterion of population density of 4 000 people/km^2 as a preliminary threshold in order to define sufficiently concentrated areas in agglomerations. For population densities lower than 2 000 people/km^2 implementation of individual or appropriate systems is proposed. When implementing the UWWTD, the ambiguous cases with population densities between 2 000 and 4 000 people/km^2 this need to be assessed on a case by case basis, considering also the local conditions, and consideration of additional environmental criteria. For the economic rational see Figure 63 below.

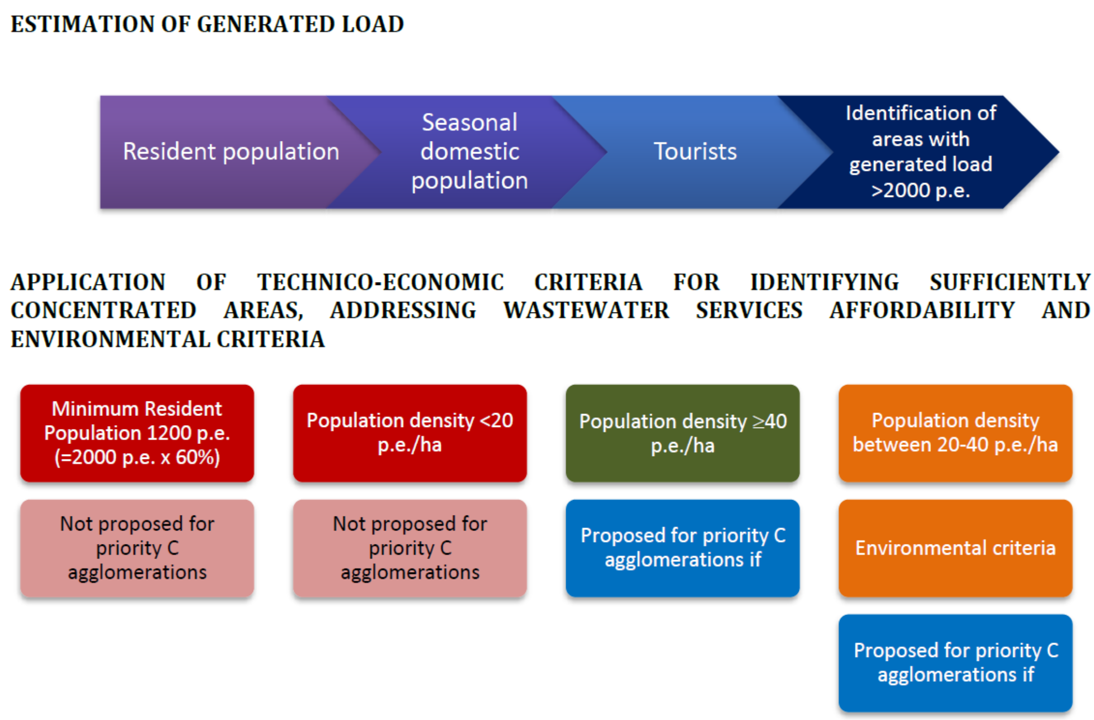
Figure 63: Comparison of construction costs of collection and treatment systems and IAS;



Source: Tools and methods for the identification of priority C agglomerations and cost estimates, EMVIS, 2018

The implementation of the above-mentioned methodology for identification of priority C agglomerations, can be summarized as follows: the first step is to determine the generated load of the communities which is followed by application of the cut-off criteria for definition of sufficiently concentrated area in the agglomeration. These criteria can then be combined with the wastewater services affordability and additional environmental criteria which are evaluated by considering sensitive areas and drinking water protected areas. **Figure 64** presents graphically these steps below.

Figure 64: Steps for identification of priority C agglomerations



Source: Tools and methods for the identification of priority C agglomerations and cost estimates, EMVIS, 2018

Following the application of these methodological steps the generated load was estimated to be greater than 2,000 p.e. for approximately 100 communities. For this group of communities further analysis was performed with the technical, economic and environmental criteria in order to assess whether the principles that define agglomerations as specified in the UWWTD apply. More specifically:

- Criterion 1 (cut-off): Minimum Resident population 1,200 p.e.: 56 communities have resident population greater than 1,200 p.e. The rest agglomerations are excluded, when considering the water services affordability criterion;
- Criterion 2 (cut-off): Population density greater than 2,000 people/km^2: 20 communities have resident population greater than 1,200 p.e., but their population density is less than 2,000 people/km^2 and these communities were excluded from further assessment since the cost for wastewater infrastructure would be excessive. The urban area of each community was determined through satellite images and the population density was calculated based on the total population;
- Criterion 3: Population density greater than 4 000 people/km^2: 6 communities have population density more than 4,000 people/km^2 and these were proposed to be

identified as priority C agglomerations. These agglomerations are Kalamos, Kalloni, Kroussonas, Mytilinii, Nea Manolas, and Verdikoussa.

- Criterion 4: Population density greater than 2,0000 people/km^2 and environmental criteria apply: 7 communities have population density between 2,000 and 4,000 people/km^2 and are located in the catchment areas of officially designated under the UWWTD sensitive areas. These are Alistrati, Assiros, Distomo, Kavallari, Kostakii, Selero, and Neon Petritsion.

After the application of the methodology the report estimated the compliance costs for 71 Priority C agglomerations: around 304 million euro for collection systems and around 185 million euro for construction of 31 WWTP.

The French experience with Urban Waste Water Treatment Directive implementation

1. French Infringement procedures – main dates

Between 1999 and 2017, France was subject to four main infringement procedures launched by the European Commission and related to the three deadlines 1998, 2000 and 2005. All these procedures are now closed.

1.1 Compliance with 1998 deadline, 130 agglomerations > 10 000 p.e.

- October 1999: Letter of Formal notice Article 258
- September 2004: France was sentenced by the court of Justice under Article 258
- January 2013: Case Closed
- Duration: 13 years

1.2 Compliance with 2000 deadline - 341 agglomerations > 15 000 p.e.

- July 2004: Letter of formal notice Article 258
- November 2014: France was sentenced by the court of Justice under Article 258
- July 2016: Case closed
- Duration: 12 years

1.3 Compliance with 1998 and 2000 deadlines additional agglomerations

- April 2006: Letter of formal notice Article 258
- November 2010: Case closed
- Duration: 4.5 years

1.4 Compliance with 2005 deadline, 551 agglomerations (<= 10 000 p.e. in sensitive area, <= 15 000 in normal areas)

- November 2009: Letter of formal notice Article 258
- November 2016: France was sentenced by the court of Justice under Article 258
- July 2017: Case closed
- Duration: 7.5 years

2. Main dates related to the management of the UWWTD

All the sanitation regulation in France is available at the following website:
http://assainissement.developpement-durable.gouv.fr/recueil.php

2.1 First translation of the UWWTD under the national regulation

In 1994 and 1996 the first sanitation ministerial Decree and Order were published

2.2 Creation of a national database

The first national UWWTD database was created in 2004.

Objectives:

Several objectives were given to this database:

- to manage the sanitation policy at each territorial level using the same information,
- to understand better how the sanitation systems work and have accurate information about each UWWTP and collecting system,
- to be able to report accurate information at EU level,
- to feed sanitation research policy with recent and up-to-date data.

Management:

- Four years were necessary to build a reliable database and 10 years to build a complete sanitation data system.
- More than 150 people are in charge of entering information in the system (100 to 200 agglomerations per person)
- Three people are required at national level: a manager, a technician and a web-tool developer
- It is necessary to check the work regularly to be sure that the data base is correctly filled

2.3 Implementation of coercive and financial measures

Due to the first sentence of the court of justice in 2004, France was at risk to pay a fine of 400 million Euros. There was a strong governmental reaction to implement measures in order to accelerate the implementation of the directive.

A new policy was implemented in 2006 to comply with the UWWTD directive. It was supported at the highest level of the Government: Prime Minister and the Minister of Environment.

Local representatives of the State in each departmental and regional levels were designated to be in charge of the implementation of this policy.

A collaborative common coherent approach was implemented at local level by the representatives of the government and the River Basin agencies.

In 2006 a new ministerial circular was published including coercive and financial measures:

- Letters of formal notice are sent to the Prefects (local representatives of the Government). The start and end dates for the works need to be specified.
- Criminal and financial sanctions could be applied if local authorities don’t respect the deadlines.
- Criminal sanctions can be applied in case of water pollution (absence of treatment following the regulation).
- Construction of new buildings is forbidden until the UWWTP is compliant.
- River basin agencies are still authorized to give subsidies to local authorities to help them build their sanitation system.
- Subsidies can be reduced if deadlines of the works are not respected.
- Prefects bear responsibilities to apply the Ministerial circular and can be summoned by the prime minister’s cabinet in case they do not comply.

2.4 Support of scientific institution IRSTEA to provide expertise for some of the situations

The scientific institution was requested to appraise some of the situations and assess the possibility to accelerate compliance.

Some of the French UWWTPs were analyzed and some solutions were proposed to reach compliance, such as:

- introduction of pure oxygen in the aerated tanks to boost the performance of the treatment;
- Injection of Ferric Chloride to reach the UWWTD phosphorus performances;
- Detailed instructions were given to operators to improve the operation.

2.5 Change in sanitation regulation. Publication of a new Ministerial Order

A new ministerial order was published in 2007 in order to:

- Merge different regulations in one to facilitate their implementation.
- Simplify and speed up procedures.
- Strengthen and improve the reliability of monitoring to better estimate the performance of the sanitation systems.
- Facilitate the evaluation of performances of the sanitation systems by the local representatives of the government.
- Strengthen the monitoring of dangerous substances in the UWWTP.
- Improve the quality of sanitation systems works and operations.

2.6 Recruitment of a senior project manager

At national level, a senior project manager with high expertise in sanitation was hired in 2007. The project manager:

- was entitled to discuss with Prefects, Mayors and operators in France and convince them to accelerate projects' implementation.
- had high expertise in sanitation technical and regulation aspects that allowed him to propose solutions for complex situations.
- was able to train local government civil servants to strengthen capacity.
- went frequently on the field to discuss with people in charge of the projects.
- was able to analyze the waste water database and detect errors.
- was responsible to prepare the answers to the European Commission concerning the reporting and the infringement procedures and to convince them of the real efforts made by France in order to avoid France to pay penalties.
- was able to design sanitation action plans and indicators to follow the sanitation policy.

2.7 Establishment of a first sanitation action plan 2007-2012

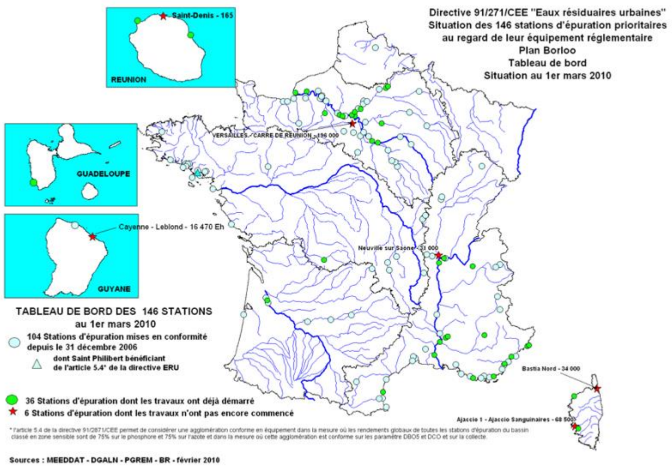
A first sanitation action plan was published in 2007 and focused on two objectives:

- The first priority was related to the compliance of the biggest agglomerations still not compliant.
- The second priority was related to the compliance of all agglomerations of more than 2,000 p.e.

The figure on the right showcases the first implemented dashboard .

The dashboard listed the 146 UWWTPs related to the infringement procedures concerning agglomerations of more than 10,000 pe in sensitive areas and 15,000 p.e. in normal areas.

The target was to have 100% of the UWWTPS compliant by 2012.



2.8 Establishment of a strategy to address the infringement procedures

The objective of France was to give provide regular updates to the European Commission for each agglomeration and UWWTP.

Updates to the European Commission were sent each 3-4 months to prove the progress of France. A snapshot of the updates is provided below:

	2010												2011												2012											
Procédures	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
1998-2110				UPD						UPD				UPD			UPD								UPD			UPD								
2004-2032					RC	UPD								UPD					UPD			UPD			UPD			UPD		RC						
2009-2306		FA		FA										UPD											UPD						UPD					

UPD Update of the answer send to EC | FA French official answer send to EC | RC EC referring France to Court

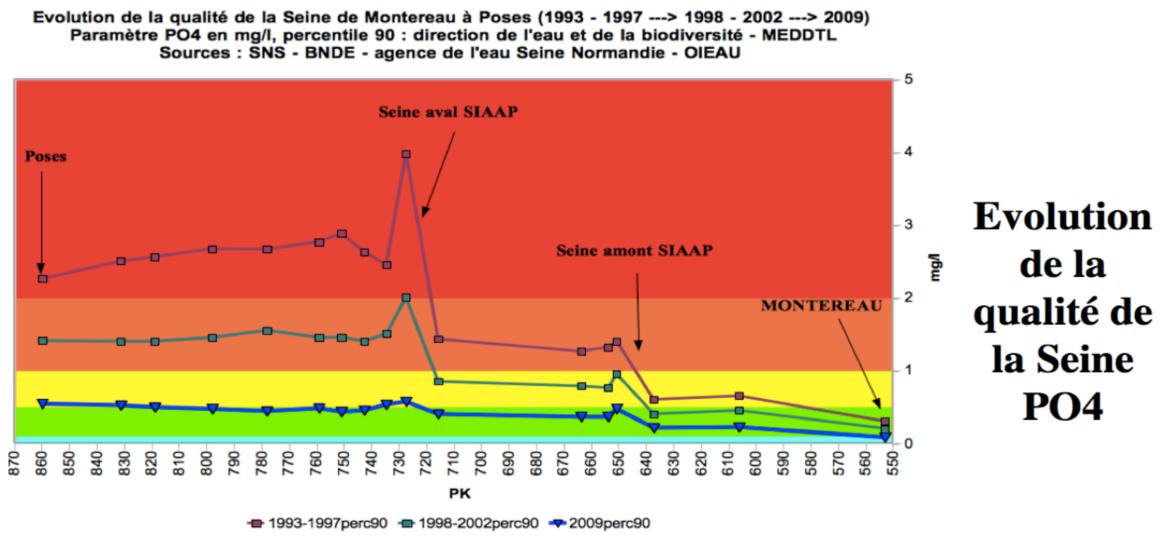
This ensured total transparency related to each situation.

A lot of proofs of actions were provided:

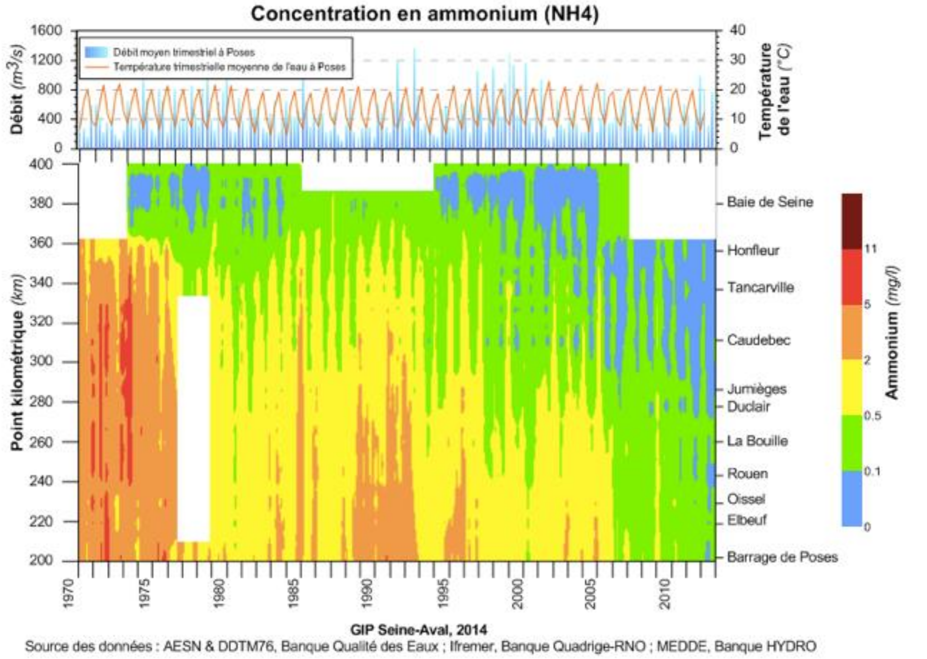
- pictures,
- newspaper articles,
- letter of formal notices taken by French authorities,
- new regulations adopted,
- financial sanctions taken if deadlines were not met,
- list of fines given for violation of the letters of formal notice,
- urbanization stopped in municipalities,
- revision of sensitive areas,
- Article 5.4.'s calculation that shows that 75% of N and P are removed in the river basin.

Proof of positive impacts of the reduction of wastewater discharges in the water bodies using different graphs related to rivers and lake previously impacted:

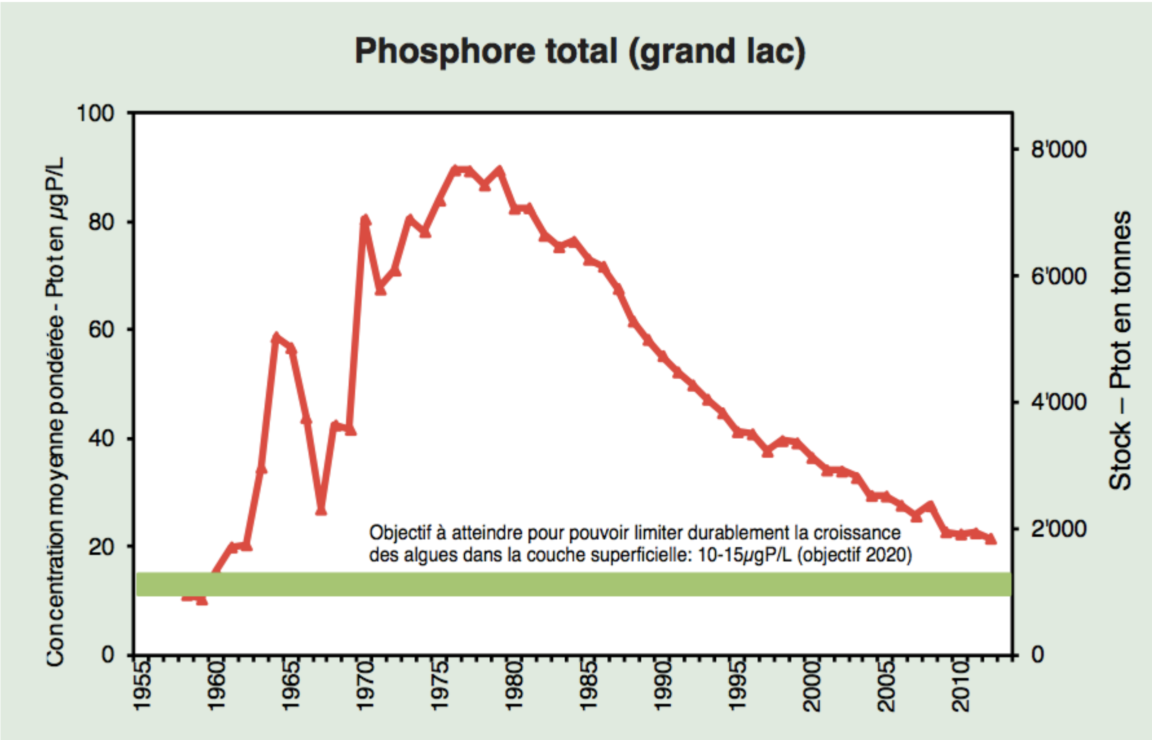
Improvement of river Seine quality- Orthophosphates



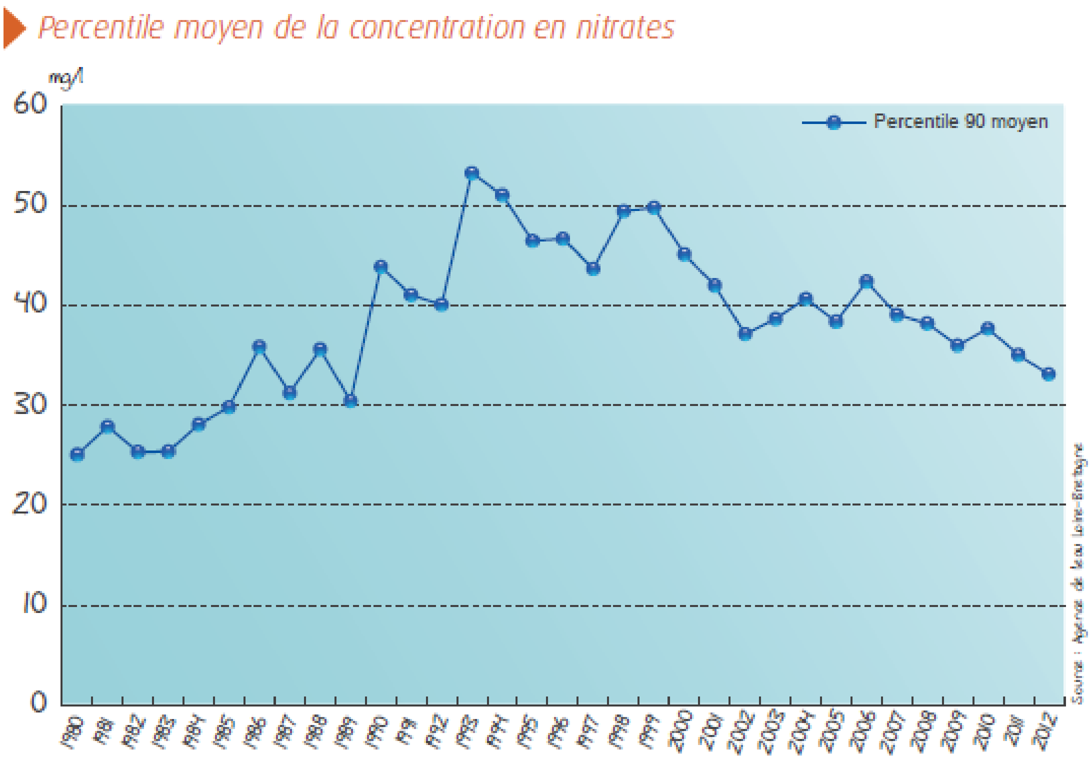
Improvement of Seine estuary quality - Ammonium



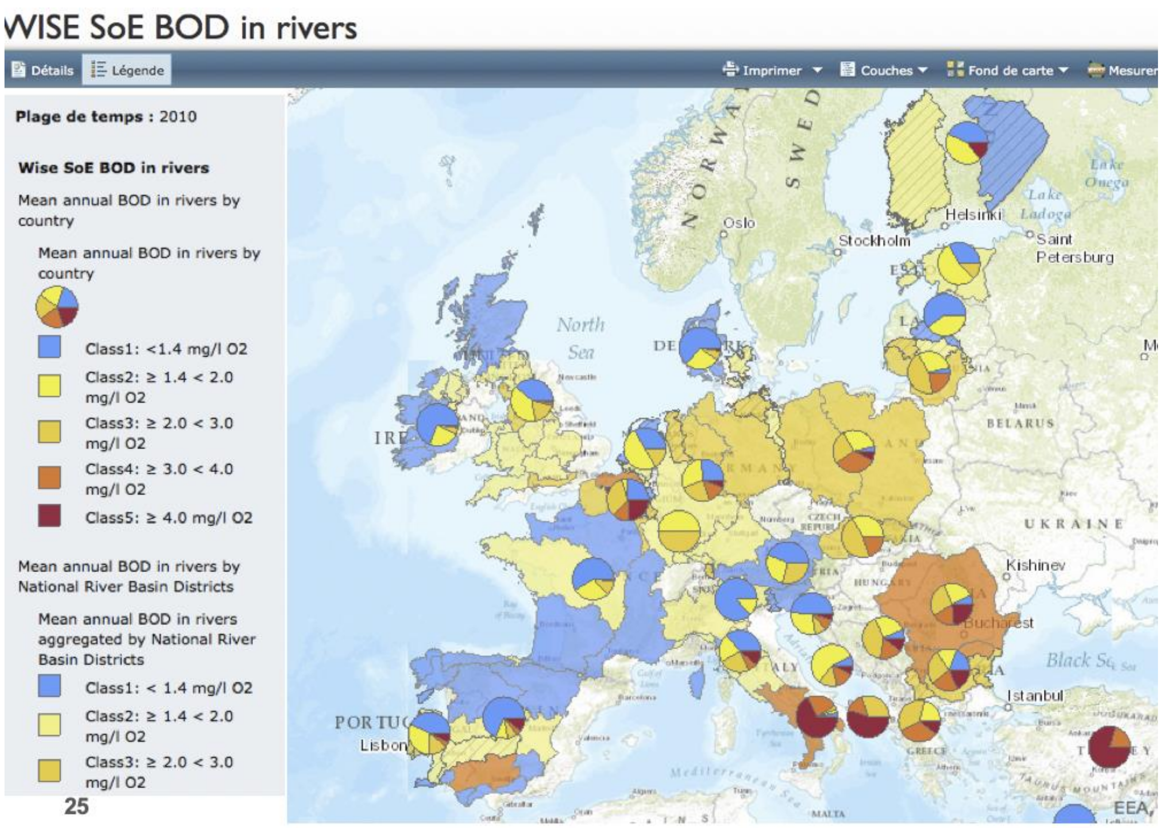
Improvement of Geneva lake – Phosphorus



Improvement of rivers nitrate concentrations in Brittany



Comparison with other countries related to river qualities and wastewater discharges impact



2.9 Implementation of capacity building

A wastewater definitions guidance was published to explain to people in charge of implementation how to implement the UWWTD. http://assainissement.developpement-durable.gouv.fr/documents/2013_06_G_def_ERU_version_2-0-1.pdf

Regulatory and technical trainings were implemented in Paris but also at local level to have direct exchanges with people in charge of the UWWTD.

There were also trainings related to the IT system established to fill the database.

A customer service center at national level was also implemented to answer to any questions.

2.10 Creation of a scientific/administrative working group to work on small treatment plant systems: EPNAC https://epnac.irstea.fr

A working group was created to deal with the small treatment plants that are much more numerous in France (more than 17,000 agglomerations less than 2,000 p.e. in France). The objectives of this working group are the following:

Acquire and disseminate information related to the design, sizing and technical operation of new wastewater treatment processes.

Analyze the different proposed technical options and provide advice related to the treatment processes.

Provide technical support to sanitation actors in small and medium-sized communities.

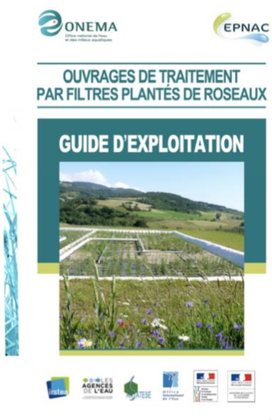
Different documents were published in order to improve the operation of some of the technologies used to treat wastewater:

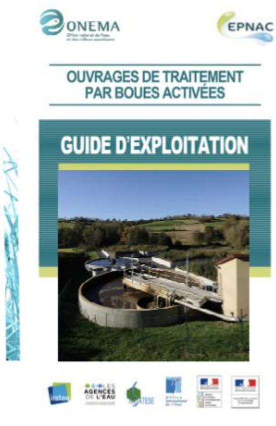
2018 Lagoons operation guidance

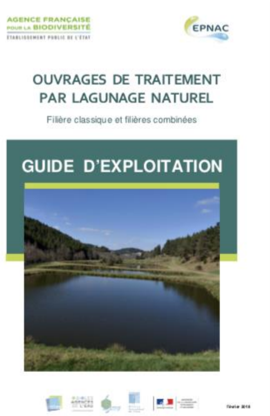
2016 Rotating biological contractors operation guidance

2015 Activated sludge operation guidance

- 2015 Reed bed filters operation guidance



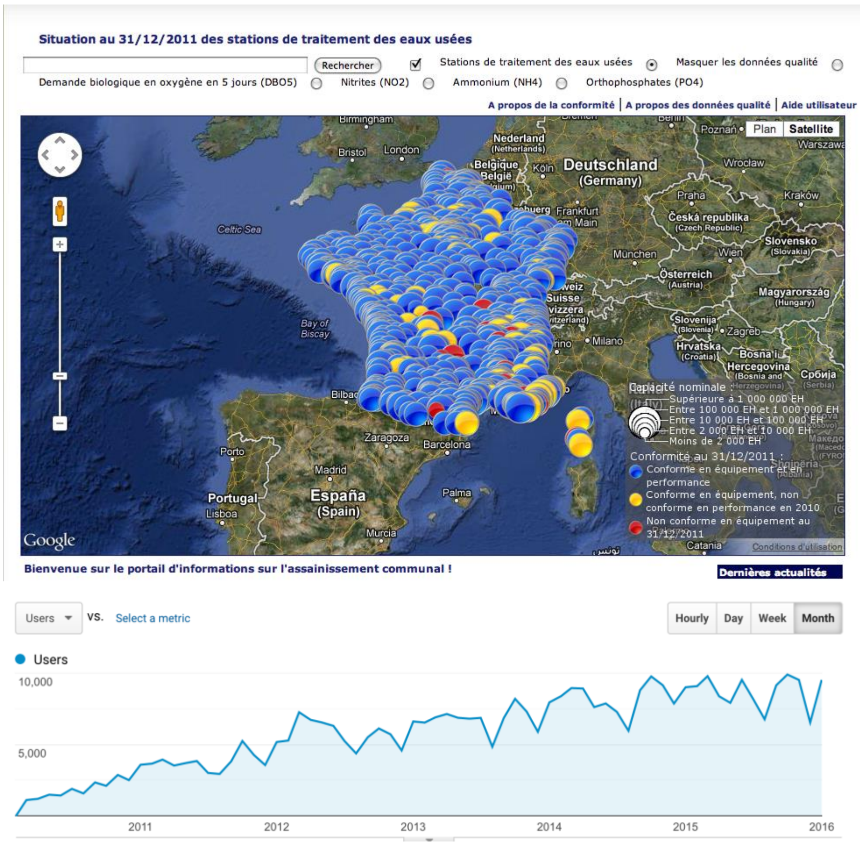




2.11 Creation of a national sanitation website

http://assainissement.developpement-durable.gouv.fr

In 2010, a wastewater sanitation website was created to increase transparency and give access to everybody to the sanitation information.



This website was very well welcomed by the European Commission and provides a marketplace for a wide-array of information and news about sanitation. (regulation, action plans and indicators, quality of rivers, sanitation tools etc.). In addition, the website:

- is now a reference for water stakeholders with more than 10, 000 unique visitors per month.
- allows France to implement the Aarhus convention.
- allows civil servants to swiftly answer questions to the public.
- Ensures a high level of transparency and reduces the controversies related to the governmental sanitation policy.
- helps to disseminate more accurate data. By also disseminating non-compliant situations (red and yellow points), it created an additional pressure on local authorities to accelerate their works towards compliance.

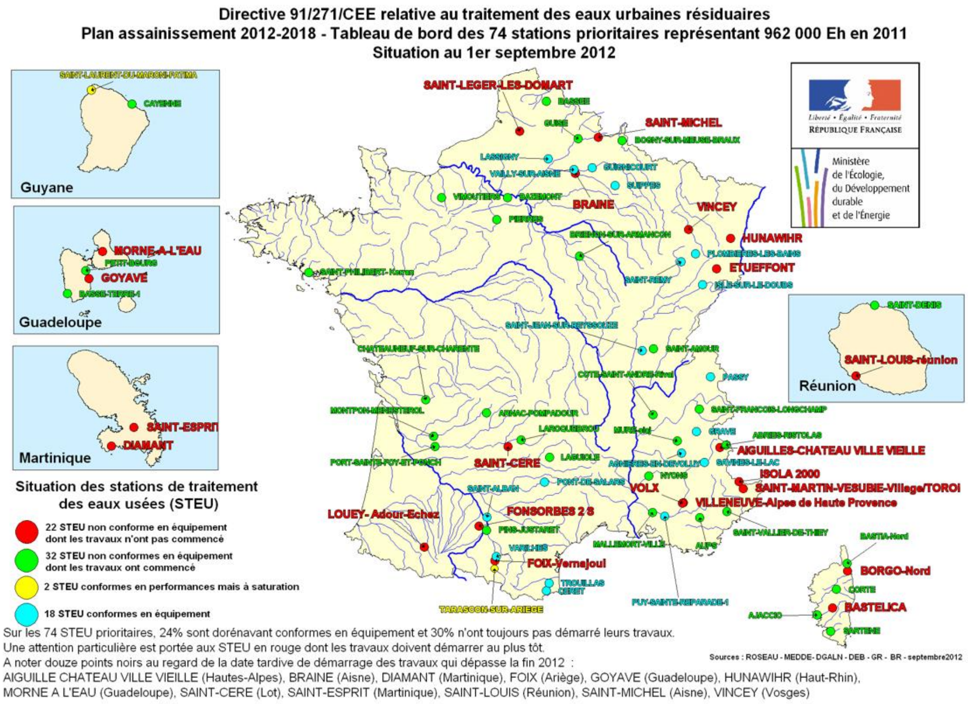
2.12 Establishment of a second sanitation action plan 2012-2018

A second sanitation action plan was published in 2011. It focused on the following objectives:

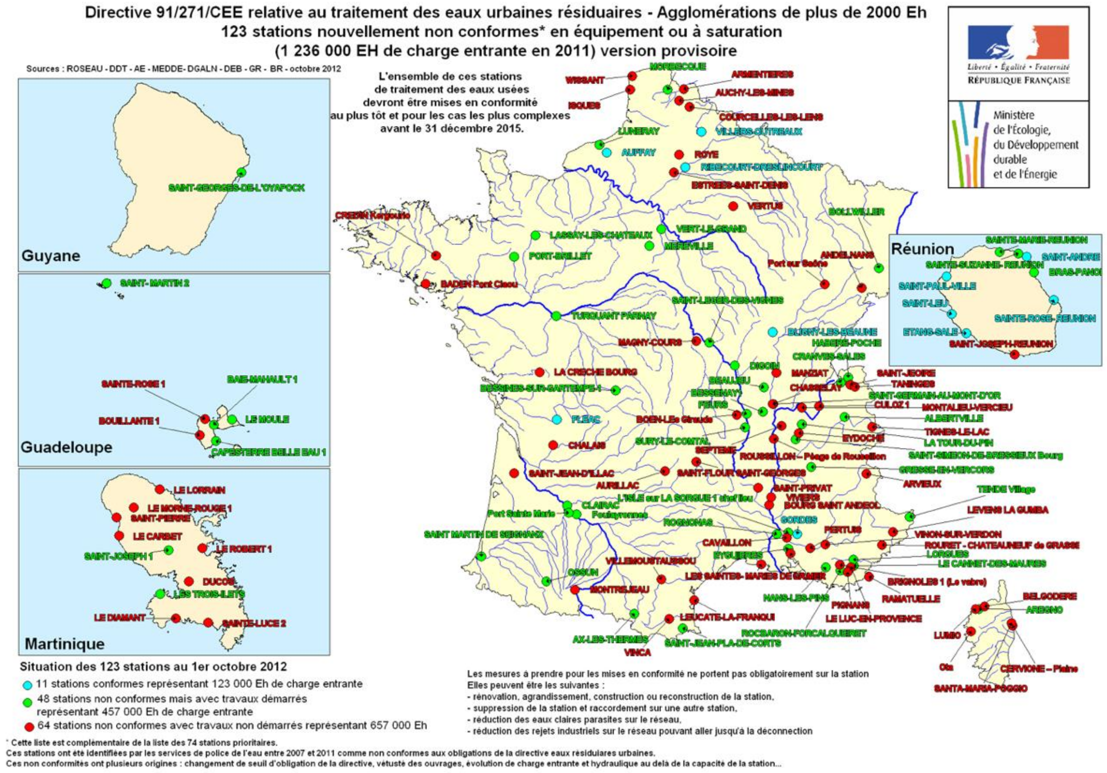
- Making sure that the sanitation systems are still compliant with the UWWTD during dry and wet weather.
- Making sure that the sanitation systems are also compliant with the WFD and other directives (Bathing and Shellfish Waters etc.).
- Focus on achieving compliance for the small agglomerations (under 2,000 p.e.).

An updated dashboard, listing all the remaining UWWTPs under the infringement procedures, was published.

List of the 74 remaining uncompliant UWWTPs within the big agglomerations



New list of 123 UWWTPs corresponding to the 2009 infringement procedure



Agglomeration delineation in France

Agglomerations boundaries were not highlighted within maps in France as the collecting systems and UWWTPs are well in place.

In most cases, it is considered that an agglomeration is made of one collecting system and one treatment plant.

When there is a continuity in urbanization, it is possible to have one agglomeration with several collecting systems and several treatment plants.

Load calculation in France

In France, the load generated by the agglomeration is based on the load entering the treatment plant.

- If there are more than 52 samples, the load entering the treatment plant is equal to maximum average weekly load. Adaptation can be done if during the week an exceptional condition occurs.
- If there are less than one sample per week, the load entering the treatment plan is equal to the maximum value of the year except if this maximum value corresponds to an exceptional condition. All agglomerations of more than 2,000 p.e. have UWWTPs with at least 12 samples.

In most cases, the generated load of the agglomeration is equal to the entering load.

For big agglomerations in France, IAS are not considered in the calculation of the generated load, as there are very few in the concentrated urbanized areas. Moreover, there is no national system to be sure of their number in a specific agglomeration.

IAS in France

There is a specific regulation related to IAS in France with a process established to test and authorize the different technologies. All the information is available in the following IAS website:

http://www.assainissement-non-collectif.developpement-durable.gouv.fr

River basin agencies encourage municipalities to use IAS when the distance between houses is more than 20-25 meters.

The basic solution that is encouraged to be used is the septic tank + sand filter followed by a soil infiltration. It is a robust system, not expensive in investment and operation. It is considered as providing the same environmental protection as requested by Article 3.

A scientific analysis was conducted to follow in-situ the performances of different technologies and the result was published in a report:

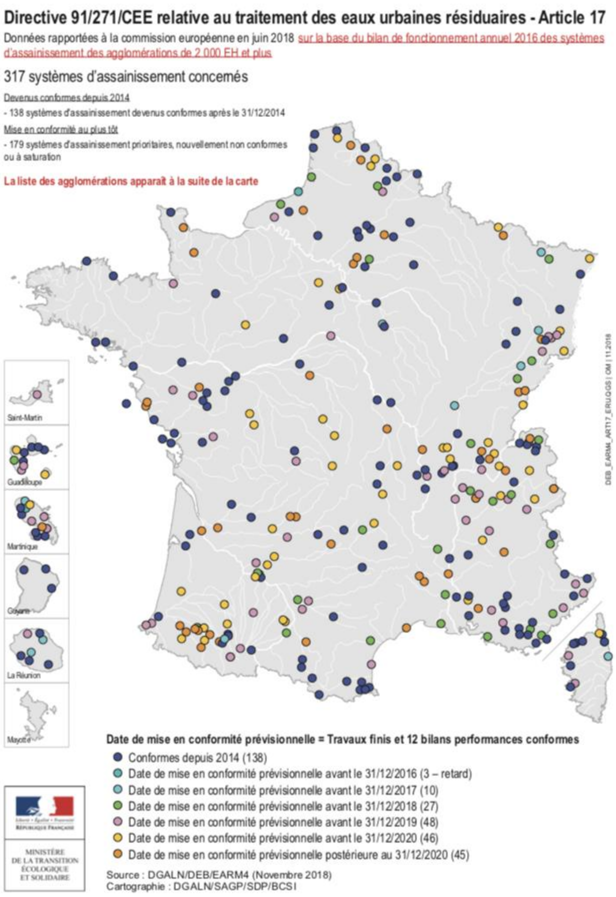
https://irsteadoc.irstea.fr/exl-php/docs/PUB_DOC/48504/2017/ly2017-pub00054553___PDF.txt

New Infringement procedure

After analyzing the 2014 French UWWTD reporting database in 2016, 10 percent of the agglomerations were still not compliant.

A new infringement procedure was launched by the European Commission on October 2017.

317 new agglomerations were listed



http://www.assainissement.developpement-durable.gouv.fr/documents/Carte_plus_liste_ART17_ERU_2018_11_09.pdf

Some of them were compliant in 2005, but due to age of the infrastructure, change in the entering load, bad operations and better knowledge about bypass during rain events, they were considered not complaint in 2014.

A new dashboard was produced in 2017 to follow the new infringement cases and provide updates within the sanitation website.

Synthesis of the French Approach to manage the infringement procedure

Different measures were taken to manage the infringement procedure and proved successful, as all the procedures open between 2009 and 2017 are now closed. The following measures were implemented:

- updates of national regulations;
- Implementation of coercive and financial measures;
- Hiring of a national senior project manager;
- Adoption of action plans, which were regularly updated with accurate objectives;
- Regular updates of dashboards;

- Focal points from the Government were designated at each level;
- Support of scientific institutions;
- Capacity building at local level;
- Reliable database and public communication;
- Providing frequent updates to the EC

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