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Final Report

PROJECT FINAL REPORT

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Final Report

Please note that the contents of the Final Report can be found in the attachment.

4.1 Final publishable summary report

Executive Summary

[All sections of chapter 4.1 are also part of the accompanying pdf file. In the pdf file, the text is formatted according to the DESSIN brand, and also contains figures and tables that are referred to but not displayed in the following text]

DESSIN demonstrated and promoted innovative solutions for water scarcity and water quality / the implementation of the Water Framework directive (WFD) and showed the value of those solutions for the water sector and society by also demonstrating a methodology for the valuation of ecosystem services (ESS) as catalyser for innovation. By this twofold approach, DESSIN was able to demon strate how innovative solutions in the water cycle can increase the value of the services provided by freshwater ecosystems, enabling a more informed selection of the most promising solutions in re gards to their impact on the water body and their economic implications. Scientists, public and private water management organisations and end-users, technology providers (SMEs), supporting RTD experts and relevant public authorities within DESSIN were collaborating to test, validate and demonstrate innovative solutions at five demo sites across Europe with special focus on urban areas. The solutions included technological, monitoring, modeling and management approaches for a more resource-efficient and competitive water sector in Europe, such as decentralized water treatment units, real time control of large scale systems, sewer mining for urban irrigation, and storage of fresh water or pre-potable water in aquifers.

The demo sites Emscher (Germany) and Hoffselva (Norway) contributed to ecosystem services re lated to water quality/Water Framework Directive and the demo sites Westland (Netherlands), Athens (Greece) and Llobregat (Spain) to water scarcity.

The final results of DESSIN are:

1. An analytical framework to evaluate and account impacts from changes in ESS suitable to the wa ter sector, finally resulting in a ready-to-use ESS evaluation module for practitioners; - validated, demonstrated and transformed into a software module.

2. Guidance for practitioners and policy makers linking good practice and lessons-learned for innova tion-friendly governance regimes and financing options, within an ESS framework.

3. Solutions for Water Quality / WFD implementation, implemented and evaluated by use of the ESS approach: (i) enhanced efficiency of decentralised treatment of combined sewer overflow by a new cross-flow lamella settlers and innovative high-rate filters, (ii) a fully automated real-time control system to minimize combined sewer overflow.

4. Solutions for Water Scarcity, implemented and evaluated by use of the ESS approach: (i) new combination of sewer mining technology with distributed ICT to enable decentralised sewer treat ment for irrigation e.g. of urban green; (ii) a solution for sustainable freshwater supply from brackish/sa line aquifers by combining Aquifer Storage and Recovery (ASR), desalination and innovative well design; (iii) a flexible ASR system to increase freshwater availability in Mediterranean coastal re

gions by deep injection systems able to deal with variable water qualities.

5. Maximised market reach of DESSIN solutions by (i) Market analyses for DESSIN technologies; (ii) a sample commercialisation process for DESSIN SMEs; (iii) business environment reports water quality and scarcity solutions; (iv) a monitoring & evaluation system for innovations; (v) showcases at five sites in Europe; (vi) promotional and educational material such as videos and leaflets on key results.

We actually demonstrated the complete set of DESSIN solutions in real environment near full-scale case studies, and at all five demonstration sites follow-up activities are now in place, ranging from additional testing to setting up full-scale applications, local replication and regional roll-out.

Summary description of project context and objectives

The main objectives of DESSIN were

• to demonstrate and promote innovative solutions to water-related challenges with a focus on: (i) wa ter quality issues related to the implementation of the Water Framework Directive (WFD) and (ii) water scarcity;
• to develop and demonstrate a methodology for the valuation of ecosystem services (ESS) as catalys er for innovation in water management;

To this purpose, DESSIN has launched demonstration projects of innovative solutions to challenges related to (i) the effective implementation of the Water Framework Directive (WFD) and (ii) water scarcity with a special focus on urban areas. The solutions were integrating technological, monitor ing, modeling and management approaches for a more resource-efficient and competitive water sec tor in Europe.

As a second key feature, an Evaluation Framework to assess the sustainability aspects of the men tioned solutions and to valuate changes in ecosystem services (ESS) of water bodies that result from the implementation of these solutions has been developed and applied.

By adopting this twofold approach, we have demonstrated how innovative solutions integrated in the water cycle can increase the value of the services provided by freshwater ecosystems while assuring sustainability, thus generating additional incentives and arguments for their market uptake and prac tical implementation. This will support innovation and competitiveness in water management by en abling a more informed selection of the most promising solutions, as regards their impact on the wa ter body and their economic implications.

The whole project was centered around a suite of carefully selected sites across Europe, (Emscher - Germany, Hoffselva – Norway, Westland – Netherlands, Athens – Greece, Llobratag – Spain), rep resentative of global major water challenges, where we brought together public and private water management organisations and end-users, technology providers (SMEs), supporting RTD experts and relevant public authorities to demonstrate this approach.

The detailed objectives of DESSIN were as follows:

1.1 Objectives of Work Area 1 (WP 11-13)

The overarching objective of Work Area 1 was to develop the new tools, accompanying knowledge and practical examples necessary to help bring the Ecosystem Services Approach (ESA) out of the

books and into practice and to expand the knowledge base on innovation-friendly governance re gimes and financing options. This was key for DESSIN to shed light on how, to what extent, and un der which circumstances the ESS concept can be used as a catalyser for innovation.

The specific goals of Work Area 1 included:

• Reviewing and outlining the state-of-the-art in ESS evaluation techniques and methodologies
• Developing a framework to evaluate the changes in ESS associated with technical or management solutions implemented at the water body, sub-catchment or catchment level
• Developing a framework to assess governance regimes, with particular focus on conduciveness to innovation
• Testing and validating the new frameworks through their practical application in the DESSIN ma ture sites (Aarhus, DK; Emscher, DE; and Llobregat, ES / Ebro, ES)
• Analysing financing mechanisms and economic policy instruments conducive to water sector innov ations
• Collaborating with Work Area 2 to migrate the ESS Evaluation Framework into a software module
• Collaborating with Work Area 3 to ensure a smooth application of the ESS Evaluation Framework in the demo sites

1.2 Objectives of Work Area 2 (WP 21-23)

Work Area 2 aimed at developing and enabling innovative solutions to improve water quality in re ceiving waters and to handle water scarcity across the demonstration sites in DESSIN.
The effect of these solutions on the ESS at the different demonstration sites was evaluated in WA3 with the standard methodology developed in WA1. The development of the software to work with the ESS evaluation methodology of WA1 in WA3 was developed in WA2.

The innovative solutions developed in WA 2 were:

• Two solutions for local treatment of CSO overflows (WP21): a new system with modular cross-flow lamella settling units for application in CSO holding tanks (T21.2), a high rate filtration system for implementation on the overflow pipe from a CSO (T21.2). Additional two tasks focus on ICT technologies for integration of local CSO treatment units (T21.3) and for reducing CSO overflow volumes by Real Time Control (RTC) (T21.4).
• Distributed reuse technologies (both modular and mobile) (WP22): sewer mining technologies (T22.1) and Aquifer Storage and Recovery (ASR) systems as potential sources for drinking water (T22.3), and agricultural or industrial water (T22.2).
• Software framework for ESS valuation (WP23).

1.3 Objectives of Work Area 3 (WP 31-35)

The objective of Work Area 3 was to demonstrate at five representative sites across Europe the po tential of a range of innovative solutions

• to tackle two major water challenges (water quality and water scarcity)
• to increase the value of ecosystem services of the water bodies

Work Area 3 integrates the technology solutions developed in Work Area 2 as well as the Ecosystem valuation approach from Work Area 1. The five full scale demonstrations including their main object ives are listed in the table below.

Table 1: DESSIN demonstration sites and work packages and their specific objectives

WP31 Emscher (DE): Improved water quality in strongly urbanised areas by implementing novel and cost efficient treatment and regulation solutions for existing CSO facilities that increase value of the ESS and serve as a pilot for a possible implementation following the reconversion process of the whole Emscher system.

WP32 Hoffselva (NO): Improved water quality in peri-urban areas using innovative decentralised CSO treatment solutions that enable cost efficient, sustainable mitigation of an overloaded sewer sys tem and increased value of the ESS.

WP33 Westland (NL): Enhanced fresh water availability in brackish coastal zone through novel ASR systems.

WP34 Athens (GR): Enhanced urban water availability through decentralised sewer mining solutions

WP35 Llobregat (ES): Increased fresh water availability in Mediterranean coastal region using flex ible ASR systems.

1.4 Objectives of Work Area 4 (WP 41-42)

The objectives of Work Area 4 were divided in:

Objectives of the dissemination and exploitation of the project results towards the scientific and com mercial sector (Work Package 41):

• To ensure a successful run-time and final dissemination of the project results to all relevant stake holders and target audiences by developing a project branding, setting up a website, producing and distributing different dissemination and communication materials and establishing demo-sites as showcases.
• To facilitate the market deployment and exploitation of the technologies through the organization of different events at the participating utilities and tailored workshops.

Objective of the Route to Market (Work Package 42):

• To maximize the market reach and impact of the water technologies, methodologies and innovative solutions developed in WA1 and WA2 and demonstrated in WA3.

In detail, the objectives of Work Package 42 were:

• To support supply side push for water technologies by developing sample development approaches.
• To assure international (European and beyond Europe) market uptake of water technologies, by ad dressing and overcoming market barriers and promoting solutions.
• To create demand side dynamics to further stimulate water technology innovation.

1.5 Objectives of Work Area 5 (WP 51-52)

The objective of this Work Area was to co-ordinate and to manage the progress of the project, in or der to ensure that the objectives will be met. This included the coordination of activities among the

Work Areas and Work Packages, facilitation of the internal communication, organization of meet ings, guidance of the decision-making processes, reporting to the European Commission, monitoring of progress, quality control of the project deliverables, re-adjustment of the work if necessary and taking care of contractual matters.

Description of main S & T results/foregrounds

2 . Main S&T results/foregrounds

2.1 Work Area 1 – Evaluation Framework

While the main exploitable foreground to come out of Work Area 1 was the DESSIN ESS Evaluation Framework, other methodologies, guidance documents and research results were generated which contribute to furthering the knowledge on ESS valuation and innovation policy.

2.1.1 State of the art report on ESS evaluation

This report (D11.1) set the groundwork to support the conceptual and practical development of the DESSIN ESS Evaluation Framework. It briefly presents the state of affairs in late 2014 regarding the measurement of changes in ESS, including description of existing classification systems, analytical frameworks and economic valuation methodologies.

The report lays out the state of affairs regarding the tools and techniques that could be used for evalu ating changes in ESS. Frameworks to illustrate the interactions between society and the environment are described and the most accepted ecosystem typologies and ecosystem service categories are iden tified. Furthermore, an overview of the current discussions regarding the links between ecosystem biophysical functions and processes and the provision of ESS is given. Criteria to identify and select indicators/proxies to investigate the links between changes in water status and changes in ESS are suggested. The challenges associated with spatial and temporal variations of ESS are also explored.

The document includes a review of existing economic valuation methods, their strengths and weak nesses, as well as their practical application within the water sector. Finally, the root elements of the sustainability assessment tool that would later be integrated into the DESSIN ESS Evaluation Frame work are described and an approach to define and measure sustainability is presented.

This document can prove a useful resource for anyone conducting an updated review of the literature on ESS assessment methodologies.

2.1.2 The DESSIN ESS Evaluation Framework

The DESSIN ESS Evaluation Framework (D11.2) is a practice-oriented, tested and validated frame work to evaluate changes in ESS that are associated with technical or management solutions imple mented at the water body, sub-catchment or catchment level. The main purpose of running an evalu ation using this framework is to facilitate the application of the ESA in the appraisal of the effects of innovative solutions on freshwater ecosystems and their services. The development process of the framework included a testing of its practical application on the DESSIN mature sites Aarhus, Em scher and Llobregat. This allowed a timely feedback loop to improve and fine-tune the framework on the basis of direct user recommendations. The improved final version of the framework was then ap plied on the DESSIN demonstration sites, which served to reaffirm its validity before the end of the project.

The dual need of having a scientifically-sound, yet practitioner-friendly framework for the evaluation of changes in ESS led to structuring it as a multi-document package. The DESSIN framework thus consists of a suite of structured reference materials that provides the instructions necessary to run an evaluation: the DESSIN Cookbook, a Companion Document, a supplementary material catalogue, a case study reporting template and a webinar. All these materials fed into the software module de veloped in WP23 and integrated into the existing MIKE Workbench Decision Support System to ease usability, promote the uptake of the framework and to enable the use of computational models in evaluations.

The DESSIN cookbook is the main interface of the DESSIN framework. It guides the user through the different parts of the evaluation, detailing the procedural steps to follow. Examples from DESSIN's mature case studies are used throughout the cookbook to illustrate this procedure. The cookbook is written as a practical guidance document and is meant to be read as a step-by-step in struction manual to fill in the evaluation template. The latter gives the user a structured outline to present evaluation outcomes.

The Companion Document presents the theoretical background considered in the development of the DESSIN framework and explains its conceptual basis. It contains a glossary of terminology which was discussed and agreed by the interdisciplinary team in charge of developing and applying the framework in the mature case studies. The document includes extensive treatment of the concepts un derpinning the different parts of an evaluation.

The supplementary material catalogue provides lists of drivers, pressures, state parameters, benefi ciary types, impact indicators and economic valuation studies that the user can refer to when conduct ing an evaluation. The catalogue functions as a quick reference directory that illustrates possible asso ciations between ESS classes, beneficiary types and the different elements of the DPSIR scheme. The catalogue was created based on a review of the relevant literature and the results of the DESSIN ma ture case studies, which comprised expert knowledge from the direct users of the framework supple mented by stakeholder feedback gathered in workshops. A database of economic valuation studies was compiled and included as a way of showing the user how different valuation methodologies are applied in practice.

By focusing on local-scale evaluations of ESS, the DESSIN framework has attempted to make ESS assessments more accessible, leaner, and yielding results that are more directly relatable and action able for stakeholders and decision-makers. The framework could be exploited in the immediate fu ture to complement the large ESS assessments being undertaken at the EU and national levels.

2.1.3 Quantified ESS for 3 mature sites including recommendations for application

This integrated report (D13.1) illustrates the results of the application of the DESSIN ESS Evaluation Framework on three mature sites: Aarhus, DK; Emscher, DE; and Llobregat, ES. The individual cases provide extensive and detailed insight into the practical application of the framework and give the reader a clear idea of the type of results that an evaluation yields (quantified ESS, measurements of change in ESS provision associated to specific measures implemented, measurements of sustainab ility on five different dimensions). At the same time it exemplifies how such evaluation results can be used for providing arguments on the values generated by the implementation of the respective solu tions.

The application of the DESSIN ESS Evaluation Framework on each of the case studies consisted of the following steps:

o Description of study area and relevant drivers and pressures
o Selection of key ESS affected by the innovative solutions
o Identification of relevant indicators to measure changes in ecosystem status and service pro vision and use
o Quantification of the case relevant ESS
o Valuation of the final ESS
o Assessment of the innovative solution with regard to sustainability aspects

The mature sites represent case studies where innovative solutions had already been implemented in the past. Therefore, it was possible to compare the status before and after the solution was implemen ted. The case studies are distributed throughout Europe in order to cover a broad geographical range with diverse environmental conditions and social dimensions. Furthermore, the case studies offer an illustration of a wide variety of ecosystem service types targeted with restoration projects. Each case was included for specific reasons and has a specific focus.

The innovative solution in the Aarhus mature case study is the real-time control of a full urban water cycle with sewers and wastewater treatment plants as well as recipient waters such as lakes, river, and a harbor. All these elements are combined into one model-based real-time decision support sys tem (DSS). The aim of this real-time DSS system was to adapt Aarhus' water system to climate change related challenges and to raise the recreational potential in the city of Aarhus via an improve ment of the water quality. Thus, this case has a special emphasis on water quality issues and recre ational values.

The Emscher site applies the ESS Evaluation Framework to individual sections of the Emscher river network for the status before and after the large-scale Emscher restoration was realized. Sub sequently, the results are transferred across the multi-site case study allowing a prognosis for the whole catchment. Service provision is, in the end, related to the costs of the restoration project for the river network as a whole.

The Llobregat study has a focus on the economic valuation of changes in ESS provision resulting from the implementation of infiltration ponds. These ponds were created in order to replenish the groundwater reserves and provide drinking and non-drinking water to the Barcelona area. The current and past status and the resulting benefits are assessed for individual beneficiaries.

2.1.4 Analytical framework for governance regime assessments

The analytical framework for governance regime assessments (D12.1) is a tool for analyzing the per formance of urban water governance and its capacity to promote innovation uptake. This is in con trast with previous theoretical frameworks which either did not focus on urban water governance or, when they do, aim to contribute to governance theory rather than supporting policy and decision-mak ing.

The framework follows a step-wise approach which entails 1) using personal knowledge, document ary evidence and close contacts for data collection and analysis; 2) identifying key knowledge gaps and carrying out a small number of interviews with relevant knowledge holders; and 3) expanding as necessary.

Rather than developing a new theoretical approach, the governance assessment framework in DESSIN primarily builds on the framework developed during the INTERREG DROP project (and previously the EU FP EUWARENESS project) and consists of three steps. The first step of the

DESSIN governance assessment framework involves introducing the case-study, its broad character istics, and the innovation(s) of interest. The second step involves answering the series of open ques tions regarding governance factors on innovation uptake. The third step consists in moving from the question-answer format into a coherent storyline of innovation uptake and governance regime influ ence.

The heart of the governance assessment tool is the series of open questions that guide the exploration of (contextual) factors influencing the uptake of technologies in the water sector, focusing on particu lar sub-national and national circumstances, as well as considering the role of European and interna tional factors. The questions are not designed to be interview questions, although this does not pre vent their use in interviews. They mainly serve to diagnose the innovation uptake, guide the analysis in a comprehensive manner, ensure consistency and comparable results, and support the development of storylines. The questions suggested in the framework are model questions that can be used as draf ted, or adapted to the particular context/information gaps.

The series of questions is accompanied by a guide presenting a structured approach to developing storylines of innovation uptake. It provides guidance on how to select the cases of innovation uptake, how to answer the questions of the governance assessment tool, and how to develop the historical storylines.

The governance assessment tool is fit for purpose and can continue to be exploited to evaluate the fa vorableness to innovation of new governance implementations at different administration levels.

2.1.5 Best practice and constraints to innovation uptake. A guide for policy-makers and practitioners

Two brief guides targeted to
i) policy-makers and practitioners and
ii) innovators (water technologies developers and water utilities)
synthesise the results of applying the DESSIN governance assessment tool in the mature case study sites and showcase examples of how to use or promote governance for pushing the uptake of techno logical innovations in urban water management (D12.3).

Lessons learned, enabling factors, best practices and constraints to the uptake of innovations are out lined into key recommendations targeted to the two audiences. These recommendations highlight crit ical governance factors supporting innovation uptake such as commitment to compromise, the neces sity to build political support and the role of coalitions. Recommendations also present the role of dis cursive strategies and partnership design, as well as that of regulative, economic and communicative instruments, in creating barriers and opportunities to initiate and secure change. The guides also high light the importance of finding multiple benefits and enhancing the delivery of several ecosystem ser vices.

2.1.6 Report on financing approaches conducive to water sector innovation

DESSIN's report on innovative and innovation-friendly modes of governance, financing and pay ment (D12.2) presents the results of an assessment of the role of economic instruments in promoting innovation uptake in the water sector. The assessment considers the role of specific policy instru ments such as public procurements, pricing policies and financing frameworks. The potential role of Payments for Ecosystem Services for innovation uptake in urban water management is explored. A list of financing and payment mechanisms is provided as well as templates for different policy instru ments, presenting their objectives, structure, and existing examples of their application worldwide.

2.2 Work Area 2 – Development and Enabling of Innovative Solutions

The WA2 was structured based on the challenges addressed (Figure 1): water quality, covered by work package (WP) 21 and water scarcity, under WP22; the work area included an additional WP, WP23, devoted to the development of the ESS module for decision support systems.

The main purpose of Work Area 2 was to prepare and support the actual demonstration of the solu tions in a real environment, which was carried out in WA3. Hence, key results of WA2 were directly utilized for real application by WA3, and the result of this final evaluation of the solutions done in WA3 will be key to the further impact, exploitation and market uptake of the solutions.

Figure 1 DESSIN WA2 structure

2.2.1 Water Quality technological solutions and results

The measures to reduce the overflow volumes or to improve the water quality in discharges from Comined Sewer Overflows (CSOs) are two complementary approaches the utilities can implement to solve the water quality challenges in receiving waters and increasing the value of the ecosystem ser vices. The innovative solutions developed by WP21 in DESSIN combine technologies acting at local and system level.

The solutions for local treatment of CSO overflows are two: a new system with modular cross-flow lamella settling units for application in CSO holding tanks and a high rate filtration (HRF) system, which does not require a holding tank, for implementation on the overflow pipe from a CSO. Cross-flow lamella settlers allow the flow to pass an inclined lamella plate horizontally while the sludge may slide down in a perpendicular direction, to avoid any re-mixing of sludge into the inflow. The HRF system has a specially designed filter media that has an optimal shape to capture debris, organic material and particles. The cross flow lamella settler was developed by the German company Um welt- und Fluid-Technik Dr. H. Brombach GmbH (UFT), combined with on-line monitoring and wireless data communication supplied by the Norwegian company LKI. The HRF has been de veloped by the Norwegian company Inrigo AS (Inrigo) also in combination with on-line monitoring and data communication from LKI (both described in D21.1).

At system level, real time control of large-scale systems can be used to reduce overflowing of CSO by controlling the hydraulic load in different parts of a wastewater network. This requires a hydraulic model of the network system and optimised performance of the available control hardware in the sys tem, e.g. actuator as valves, gates and volumes. The solution developed in DESSIN is the ADESBA-control box, which is an innovative fully automated real time control system to minimize combined sewer overflow. The ADESBA-RTC system was developed by the German company SEGNO Indus trie Automation GmbH (D21.2).

The focus of WP21, coordinated by SINTEF, has been i) on site-specific testing of the HRF solution in the Hoffselva site, ii) development and testing of monitoring and control solution of the cross-flow lamella settler plant in the laboratory first and in Hoffselva site afterwards and iii) on the develop ment and testing of the software for the ADESBA system for RTC to reduce CSO volume.

2.2.1.1 Cross-flow lamella settler

The cross-flow lamella settler was developed in WP2.1 as a prototype by UFT. The modular cross-

flow lamella settler unit allows the local treatment of combined sewer overflows from tanks.
In WA2, model tests were conducted in a reduced-scale model. The model tests and interpretation of results have been conducted by UFT and UDE.

The objective of the model tests, using spherical plastics beads as model sediment, was to investigate the behaviour of sediments and to establish efficiency curves for given flow and sediment character istics.

The experiments were conducted using tap water as well as salt water of different density in order to vary the settling velocity as the most essential parameter. Steady-flow efficiency curves were gained which showed that the efficiency decreases with increasing surface load as well as with decreasing settling velocity. The evaluation was made in dimensionless form to allow scaling and possibly trans fer to prototype size.

Comparison with similar curves from upflow lamella model experiments was possible under some as sumptions, but only slightly better efficiency could be obtained. One essential fact is the coaction of the settler modules and the vessel in which they are placed. Moreover, the results indicated that there is re-mixing of already settled sediments into the flow. Generally, it was found that the overall sedi ment removal efficiency of a lamella settler is not governed by the sedimentation process only, but also to a large part by secondary effects such as the flow-induced sediment transport on the settler surface and, particularly for real sewage sediments, by sticking to the lamella surfaces and by forma tion of sediment flakes affecting sliding-down. This made it difficult to reliably predict the perform ance of real lamella settlers from model test data. However, some findings indicate that the prototype efficiency should be considerably better than derived from model data. It was thus essential to test the settling efficiency of the prototype lamella settler by container tests at Emscher and Hoffselva (WA3).

2.2.1.2 High rate filtration system

An innovative high rate filtration (HRF) system has been developed and applied for treatment of a combined sewer overflow (CSO) by Inrigo AS from Norway. In WA2, a container type HRF plant was built to investigate and later demonstrate the treatment efficiency for treatment of CSO. The HRF can be installed on the CSO outlet of a wastewater pipe for smaller structures without a holding tank.

The HRF plant was placed at Hoffselva, Norway, where site specific testing has been performed to give basis for final design. The new HRF system for CSO has special filter media which are floating in the filter bed. The filter media is designed to have optimal shape to capture debris, chemical oxy gen demand (COD) and suspended solids (SS) with high void ratio. There is no chemical addition and pre-treatment required for this new HRF system. During the operation, filtration and backwash are switched by a backwash valve that is closed and opened, controlled by inlet water level. Filtration water flow is not stopped during backwashing. The motorized equipment consists only of inlet pumps (no pumps needed if gravity flow is available) and a compressor for pneumatic valves. During rainfall, CSO raw water comes in from the distribution channel flowing upwards through the filtra tion layer. Sewage garbage is deposited on the surface of the filter bed, while SS and COD removal will take place also in the internal parts of the filter bed. As filtration continues, and filter media be comes clogged, the water level on the inlet side will rise. When a predetermined maximum water level is reached, the high-speed drain valve opens automatically and starts backwash. Filtrated water flows downward by gravity and sewage garbage, SS and COD accumulated in the filter media is dis charged. The backwash cycle requires only a minute, and no filter media flows out during backwash.

Eleven (11) CSO events were recorded during the first testing and demonstration period, from September 2015 until May 2016. Test results indicated that the HRF solution was a promising tech nology to reduce emissions of particulate pollutants from CSO. Up to 80% of SS removal and 75% of COD removal were documented during the first flush. The overall removal of SS and COD were about 47% and 56%. Nutrient removal was relatively low because of the high fraction of soluble ni trogen and phosphorus in CSO. However, 6.3% TN and 15% TP were retained together with particles. The HRF system also showed promising treatment efficiency for heavy metals with 48% Al, 48% Zn, 57% Cu, and 31% Cr removed, respectively.

2.2.1.2.1 Integration of local CSO treatment units by monitoring and data communication
An on-line monitoring system has also been designed and implemented by LKI with on-line sensors, a data acquisition manager with wireless connection enabling data transfer and remote control of the plant.

The on-line monitoring system allowed to monitor the state of the HRF and performance during CSO events. This was possible by logging of plant sensors and installed turbidity sensors on the inlet and outlet to a local data logger. This data logger was set to log data every 10 seconds, but had the possib ility to start logging upon triggering of an alarm or set-point, and the frequency of data collection could be adjusted. The locally stored data were transferred to SINTEF using wireless transfer and an internet based access to the local computer with the logged data.

In addition to the solution for the treatment plants at the CSO site, a solution for remote start of a sampler in the Hoffselva river downstream of the CSO site was also designed and installed. To log the additional on-line data, the data acquisition manager (DAQ Manager) installed on a PC with wire less internet connection using an ICE router, was extended with additional channels.

The online monitoring system has then been used also for the lamella settler once transferred to Hoff selva (WA3). For both the HRF solution and the lamella settler, data can be stored on the PC and can be transferred to other users at the project partners. Remote access to the desktop of the PC also en ables remote start/stop of the plant.

2.2.1.3 Reducing CSO overflow volumes by Real Time Control
The ADESBA real-time-control (RTC) system to enhance storage of combined sewage inside the sewer network, was developed by DESSIN-partner SEGNO.

The aim of ADESBA is to utilise the total storage capacity of the wastewater network; to this aim, ADESBA needs minute by minute information of the inflows of every storage reservoirs as well as on the CSOs and water levels. During rain events the inflow to storage reservoirs is greater than the regular outflow. To avoid reservoir filling, the settings of the throttle (tanks's outflow regulator) have to be adjusted. For this, the RTC ADESBA algorithm creates an outflow "request" from a storage up stream and sends it to a storage below where it has to be checked if the volume to be transferred from above to below can be stored. The ADESBA control system will send a permission, a rejection or a suggestion, in terms of new throttle settings, back to the storage upstream. The aim is to achieve equal fill level in all tanks. In this way, RTC can reduce the volume of overflows into natural streams or avoid CSOs completely.

The RTD activities to prepare the ADESBA RTC for demonstration in WP31 were: standardization of function blocks; development of the ADESBA modules for use in process control systems; prelim inary investigation of the production optimization of the encapsulated modules; and upgrade of the

ADESBA Planner with a web-based online module and recalibrated function. These were delivered according to plan and enabled a successful functional testing of the software at a cluster of five CSO facilities in WP31.

2.2.2 Water Scarcity technological solutions and results

The water scarcity challenge can be tackled with innovative solutions both on the clean water and waste water side of the water cycle. Present water treatment systems are very robust, but, as a result, do not have the flexibility to deal with changes in climate, demography, water demand etc. There fore, (waste) water reuse is highly dependent on the development and implementation of new distrib uted concepts based on e.g. modular systems that provide the flexibility to quickly react to (quality) requirements on the demand side.

The solutions developed in WP2.2, coordinated by KWR, include distributed reuse technologies (both modular and mobile) with focus on sewer mining technologies and Aquifer Storage and Recov ery (ASR) systems to be demonstrated, with further adaptation to different water-quality injection sources, as potential sources for drinking water, agricultural or industrial water.

2.2.2.1 Distributed Reuse (AMI-enabled Sewer Mining)
Within the concept of the DESSIN project an innovative solution for urban wastewater reuse is evalu ated, namely sewer-mining (SM). SM extracts wastewater from local sewers, treats it at the point of water demand and supplies local urban wastewater non-potable uses (such as urban green irrigation) while returning treatment residuals back to the sewer system for eventual treatment in the centralised wastewater treatment plant, thus eliminating the need for expensive conveyance systems. Therefore, SM is considered a decentralized technology that is closer to the circular economy concept, in that by closing the loop between waste and resource locally, wastewater becomes not ‘just’ a by-product of the urban wastewater system with some potential for reuse, but a resource per se, also decreasing (or eliminating) the barrier of wastewater conveying costs.

The Athens Pilot, coordinated by NTUA, brings together two emerging technologies:
• The membrane bioreactor (MBR)/ Reverse Osmosis (RO) unit which is a hybrid technological product that on the one hand employs membrane technology to treat sewage and on the other hand, in case this function fails, can operate as conventional type of WWTP. MBR and RO units are construc ted as individual containers (modular) that are joined together in one containerized compact system offering ease of transportation to be deployed either individually or in combination (depending on re quirements).
• Fully automated packaged treatment plants featuring membrane based, small footprint, sewer min ing technologies that allow direct mining of sewage from the network, close to the point-of-use with minimum infrastructure required and low transportation costs for the effluent.

Within the framework of the DESSIN project the two concepts of SM and MBR have been joined in an effort to develop an efficient wastewater reuse system. The MBR system provides both secondary and tertiary wastewater treatment. Secondary treatment with biological nitrogen removal is achieved within the MBR system, where most of the organic matter and the suspended solids are removed. Re moval of residual particulate matter requires further tertiary treatment through a filtration process, which is also incorporated within the MBR. It is also notable that the MBR system provides adequate pre-treatment for a nanofiltration or a reverse osmosis system. Such advanced membrane treatment systems may be required when dissolved constituents are present in treated wastewater in amounts that limit wastewater reuse. A report with the focus on new membrane solutions and technologies in the form of modular packaged treatment solutions (MPTS) was delivered as D22.1. The deliverable

includes a benchmark study undertaken to provide rules for the optimization of the operation of the proposed membrane wastewater treatment system. Based on the results of the benchmark study, the most critical parameter on the performance of the treatment is the solids retention time (SRT).

According to the benchmark study the optimum operating conditions for the MBR system can be summarized to the following:
• Minimum dissolved oxygen concentration in the bioreactor: 2 mg/L
• Minimum internal recirculation ratio: 400%
• Minimum mixed liquor suspended solids concentration in membrane tank 8 g/L
• Minimum solids retention time: 15 d

A sewer mining software and hardware platform and the required communication solutions, for col lecting, processing and visualizing data of field sensors have been developed and tested at the pack aged plant in KEREFYT, Sanitary Engineering Research and Development Center of EYDAP.

The System Architecture (SW and HW) has been designed with Software and Hardware components, system structure and interoperability; this also includes: design and development of interoperable sensor data layer based on Open Geospatial Consortium (OGC) suite of standards; design and devel opment of the server-side (back–end) software application using J2EE technologies; design and de velopment of the server-side (back–end) software application using J2EE technologies; testing of the s/w platform using “dummy” data.

The communication solutions have been designed taking account the topology of the pilot site and field sensor installation, the communication link requirements and the cost of the solution to be used; the software platform (web application) on a secure web server has been developed in order to sup port the link of local events to a remote management center; the sensor data layer has been integrated with the web enabled local and remote monitoring user Interface. The most interesting result/ achievement is that the communication solution and the developed software platform are enabled with local and remote management capabilities and is based on standards, low cost solutions and open source implementations. The SME TELINT contributed to the collection of data from the vari ous sensing elements (collection tools) and set up the communication and networking between the collection tools and the front-end system.

The research has also focused on the identification of potential locations for sewer mining units at city level. The study demonstrated the impact of the solution at the city-as-a-catchment scale (modelling), identified opportunities/barriers (e.g. regulation changes) and assessed the governance/ policy implications of the proposed solution. The ICT platform for distributed sewer mining (technology) was delivered as D22.2.

2.2.2.2 Aquifer storage and recovery and reverse osmosis (ASRRO)
The aim of the research performed was to increase the potential for freshwater storage, in particular in near coastal areas where saline groundwater prevents application of available technologies for tem porary storage, by developing innovative well design and operation in combination with desalinisa tion.

In the Dutch horticulture area Westland an ASR-Reversed Osmosis (ASRRO) was installed in brack ish (3700 – 4700 mg Cl/l) coastal aquifer (coarse sands, 14 m thick) to inject the rainwater surplus of 27ha of greenhouse roofs in an aquifer (23 to 37 m below ground level). The aim was to demonstrate that a sustainable and reliable freshwater supply can be obtained by combining the techniques of ASR and reversed osmosis in one system (ASRRO). A Westland ASR groundwater transport model

was set up (SEAWAT) and injection/recovery schemes quantified; the optimal well configuration was also determined.

The freshwater recovery was quantified and optimized by use of Multiple Partially Penetrating Wells (MPPW), use of the Freshkeeper at the base of the freshwater bubble and by integrating the Reversed Osmosis. The research was coordinated by KWR as collaboration between KWR and Bruine de Bru in.

The cycling of infiltration of fresh water in winter periods and the recovery of fresh water in summer periods was monitored. Monitoring results showed:
1. In the first 1,5 years of operation (December 2012 – July 2014), approximately 20% of the injected water was recovered practically unmixed.
2. Based on the hydrochemical monitoring and groundwater transport modelling, it was found that a deeper borehole of a close by ATES well (realized before the start of the pilot) caused leakage of deeper saltwater, contaminating the water recovered by the ASR system.
3. The installed Freshkeeper proved to be indispensable to attain the still relatively high RE achieved.
4. Despite the leakage of deeper saltwater, the Westland ASR-system proves to be effective to ab stract different water qualities separately and attain a significantly better ASR-performance than a conventional system would achieve.

As general result, the ASRRO solution proposed can potentially boost the recovery efficiency of freshwater upon aquifer storage from 30 to 60% at the field site, making it a reliable and economic ally viable water supply solution. Due to local conditions, this performance was not achieved at the site.

An assessment of membrane clogging by varying redox conditions of the feedwater was performed with the following conclusions (D22.3):

1. When combining aquifer storage and recovery (ASR) and brackish water reverse osmosis (BWRO) in one integrated ASRRO-system (ASRRO), the formation of suspended fine particles in the aquifer's pore water forms the main threat during the RO-treatment process.

2. The particles are released during injection upon aquifer freshening and presumbly also upon oxida tion of Fe(II) in the target aquifer by the injected oxic rainwater. As the particles are moved to the fringe of the injected freshwater body, abstraction of water in this zone leads to membrane 'fouling' (experienced at BWRO-plant the Westland site).

3. No fouling was observed at the ASRRO-plant, fed by the deepest ASR well screens (ASRRO) with brackish water from below the injected freshwater.

4. Dosing CaCl2 to the rainwater before injection may significantly reduce the particle formation, but needs further study.

5. Filtration of RO-feedwater before the RO-plant is a technically viable solution, but leads to a signi ficant increase in the cost price. Regular flushing is a low-cost solution, while on the long-term, relo cation of the complete abstraction to the deepest ASRRO wells seems most promising.

As a general result, the treatment of the mixture of injected rainwater and brackish groundwater is technically viable, but requires careful consideration of the abstraction depths and the RO-treatment process. Guidelines are provided based on the DESSIN research.

2.2.2.3 Increase the flexibility and resilience of Aquifer Storage and Recovery (ASR) in strategic groundwater reservoirs

The research, coordinated by CETaqua and performed in collaboration with A21, aimed at increasing the flexibility of storage in strategic groundwater reservoirs by using different types of water qualities from the drinking water treatment chain, without compromise the comply with WFD.

Exhaustive literature review of recommendations and compilation of international experiences of ASR systems and their main operative parameters was produced and results are available in deliver able D22.4A. Historical data of the sand filtered water produced has been plotted and analysed com pared to quality standards and recommendations. A regional numerical flow model was set up and used to evaluate the impact assessment of ASR in terms of groundwater volume infiltrated in the aquifer and the improvements and/or impacts in groundwater quality (conservative transport).
The work has been divided in two parts:
(i) MODFLOW-based numerical model to simulate the impact on injected water in the local piezo metric network installed for the project (4 km2)
(ii) VISUAL TRANSIN-based numerical model to simulate the impact of ASR and ASTR at regional scale (129 km2).

The review of guidelines and recommendations reported in international literature has been also ap plied to the Sand filtered Water (SFW) characterization. Data from 2010 to 2014 of SFW have been plotted and aggregated in ranges to evaluate the frequencies and mean values of the bulk chemistry. Total suspended solids, Modified, Turbidity, dissolved organic carbon, total organic carbon; assimil able organic carbon, E. coli and ammonium are the parameters mainly reported as clogging and pol lution control in ASR injection.

A numerical model has been built to simulate the positive impacts over groundwater quality and quantity in a typical Mediterranean deltaic aquifer (based on Llobregat delta aquifer, Spain) with the objective to bring an easy visualisation tool to MAR implementers. The model takes into account the interaction between surface and groundwater.

2.2.3 Software framework for ESS valuation

The outcome of WA1 is a standardised, broadly applicable ESS methodology that can be applied to valuate ecosystem services (ESS) of water bodies and the sustainability of the proposed solutions. The aim of WP23, coordinated by DHI, was to make this methodology available in a software system that can be configured and applied to different sites and eco-systems to assist the user in valuating different ESS strategies.

Work on WP23 was completed with delivery of D23.2 (Windows installer for the ESS evaluation software) and D23.3 (user guide and documentation). The software was then used by all demo site partners to carry out the DESSIN ESS evaluation and Sustainability Assessment, as part of WA3 activities, thereby fulfilling the objective of the work package within DESSIN.

The software development was carried out according to specifications described in D23.1. The spe cifications were developed in cooperation with the demo site partners, as well as other partners in volved in the development of the DESSIN ESS framework and Sustainability Assessment (WA1). The specifications outline how the software should look and function in order to assist users imple menting the ESS framework and Sustainability Assessment.

A beta version of the software was made available to partners for testing in January 2017, and feed back from the testing was used to refine the tool and eliminate defects. Partners were also provided with a trial version of the documentation, which was also revised based on user feedback. The final version of the documentation is available as a context-sensitive help file in the software tool.

To contribute to the legacy of DESSIN, the software tool will continue to be maintained by DHI, and will be available to the public for free. Instructions for downloading and installing the software have been made visible to the general public through the DESSIN home page.

2.3 Work Area 3 - Demonstration

2.3.1 Improving water quality in a highly urbanized area (Emscher - WP31)

The Emscher demo case (Germany) aimed to demonstrate the feasibility and effect on ESS of two in novative solutions. Both were developed to mitigate the negative effects on the water quality in the Emscher river system caused by CSO events during rain.

The two demonstrated solutions are:
- A cross-flow lamella settler as a solution of local treatment of CSO overflows. The lamella settler aims at reducing the particle concentrations in overflowing water. The lamella settler was developed by UFT as a container solution and was tested at a CSO facility in Castrop-Rauxel from June 2015 to May 2016.
- The ADESBA RTC system for controlling water levels in storage volumes in the sewer system. Aim is to reduce overflow volumes from CSOs. The practical application of the ADESBA-RTC has been developed by SEGNO and was implemented in Dortmund in June 2016. After a testing phase, the RTC was activated in April 2017 and data gathering was conducted until November 2017.

Two deliverables have been completed: D31.1 as a technical report on the results of the two Emscher demonstration cases and D31.2 as the evaluation of the two demo cases with regard to ESS and sus tainability.

The demo activities in the Emscher river system have resulted in the following foreground:

- Cross-current lamella settler
o The highest efficiency (i.e. reduction of TSS, TSS fine, COD and TOC) were detected at a flow rate of 10 l/s and lower. The recommended surface load is thus about 1 m/h.
o The container starts to be efficient at an inflow concentration threshold of approximately 300 mg/L COD.
o The efficiency ranges from 5 to 17 % for COD.
o The maximal potential efficiency that can be reached with the lamella settler in its current setup is 37 % (TOC), 17 % (COD), 22 % (TSS fine) and 19 % (TSS).
o The particle concentration and type is of high importance for the efficiency.
o The efficiencies detected were scaled up from container scale to large-scale CSO, predicting over flow load reductions of 5.9 to 17.2 %.

- RTC of sewer network
o Newly developed visualization interfaces served to monitor the RTC of the full system, i.e. the five ADESBA-controlled CSO facilities, at a glance and online at any time from the central office.
o Furthermore, templates for raw datasets and graphical reports were developed which were popu

lated with data of the monitored rain events.
o The monitored overflow behavior (volume and duration) with ADESBA was compared to the over flow behavior simulated in Simba#, which calculates the situation without ADESBA. Reductions of overflow volume of up to 37.3 % were detected.
o Furthermore, an analysis of potential was conducted for the entire sub-catchment of the WWTP Dortmund Deusen, i.e. 36 CSO facilities, simulated in Simba#. Potential reductions of overflow volume of 3.8 to 7.5 % were determined.

Both demo case solutions have been evaluated with regard to their effects on ESS. ESS are expected to be enhanced via an improvement of water quality. This means that pressures on the ecosystem are reduced via the two technologies. The lamella settler reduces the particle concentrations in overflow ing water. This again reduces particle, organic cabon, nutrient and contaminant input into receiving streams. The RTC minimizes the overflow volume and frequency. Thus, in-stream flow peaks are shortened and potentially even avoided. Going along with a reduced overflow volume, a reduction of the overflow load is predicted. For both technologies, a thorough sustainability analysis has been con ducted in order to appraise further criteria which have not yet been examined in the ESS assessment. Here, criteria like investment and operational costs and effort have been estimated as well as poten tial risks and probability of failure. Furthermore, energy consumption and compliance with the WFD have been predicted and discussed.

2.3.2 Improving water quality in a peri-urban area (Hoffselva – WP32)

The Hoffselva river (Oslo area, Norway) suffers from discharge of combined sewer overflow (CSO) during high rain events, with a negative impact on water quality and the recreational value of the area. Within DESSIN, two innovative solutions and their benefits to improve that situation were demonstrated: i) a high rate filter developed by the Norwegian company Inrigo AS (Inrigo) combined with on-line monitoring and wireless data communication supplied by the Norwegian company LKI, and ii) a cross flow lamella settler developed by the German company Umwelt- und Fluid-Technik Dr. H. Brombach GmbH (UFT), also in combination with on-line monitoring and data communica tion from LKI. The demo site owner at Hoffselva and the utility owning and operating the sewer sys tem was the Water and Sanitation Agency of Oslo Municipality (VAV).

The innovative high rate filtration (HRF) system and cross-flow lamella settler (CLS) have been in vestigated in parallel for local treatment of CSO discharge at Hoffselva. 13 CSO events have been re corded during the demonstration period in 2017. Online Turbidity measurement and water quality lab analysis were performed to document the treatment efficiency. The demonstration results indicate that the local CSO treatment is an effective method to reduce the emission of particulate pollutants into river. Finally, the design criteria of HRF and CLS plants are proposed for CSO local treatment at Hoffselva.

On the one hand, the solutions were assessed with regard to their technical performance the direct ef fect on river water quality, but also with regard to their benefits and co-benefits in terms of the Eco system Services (ESS) provided by the river, and with regard to their sustainability.

Water samples were collected in the downstream section of Hoffselva at Skøyen, and at the inlet and outlet of the demo plants. The performances of the demo plants were also monitored on-line with sensors for turbidity and operation parameters such as relevant water levels and pressure drops. The instrumentation, data logging and communication equipment facilitated remote monitoring and con trol of the demo plants.

Operation of the demo plants did not have an impact on the water quality in Hoffselva. In the evalu ation of ESS, a value of 252 mg SS/l has been applied as a typical peak concentration of suspended solids in the river during situations with CSO discharge before any implementation of the solutions. Similarly, a value of 8 mg SS/l has been applied as a typical concentration of suspended solids during conditions without any CSO discharge.

An estimate of the concentration during CSO discharge with distinct levels of implementation of the two solutions has been found based on the reduction in mass discharge. Several sources of uncer tainty have been identified. The results, however, illustrate the importance of the storage volume. The separation technologies, i.e. the CLS and the HRF, were found to have a relatively small contribution to the total load reduction. The results also indicated that the implementation alternative, i.e. the num ber of CSOs where the local treatment is implemented and the risk classification of these, is of higher importance than the choice between the two solutions demonstrated in this study, i.e. implementation at many CSOs with the CLS solution will probably improve the conditions more than implementing at a few CSOs with the HRF solution despite a higher separation efficiency. As expected, the highest improvement is indicated for the implementation alternative with use of the solution with highest sep aration efficiency at most CSOs.

The pair-wise comparisons of results show that the differences between the two solutions are mainly related to the differences in the separation technologies, but that the overall removal for a given im plementation alternative, and thereby the effect on compliance, is similar. There are also some differ ences in energy consumption and costs. As expected, larger differences in costs are found in the com parison between implementation alternatives irrespective of solution. The differences in overall re moval and thereby also compliance, can also be expected to be larger between implementation altern atives than between solutions for a given implementation alternative.

2.3.3 Freshwater supply for horticulture from brackish aquifers (Westland – WP33)

From 2014 to 2017, a pilot was conducted at the Westland Demo site in order to integrate ASR, the Freshkeeper, and desalination in one system by consortium partners KWR Watercycle Research Insti tute and SME Bruijne de Bruijn, both from The Netherlands. The objective was to create a sustain able and robust freshwater supply, using the characteristics of the aquifer as an ecosystem service. This advance ‘ASRRO’ system must improve the freshwater recovery upon conventional ASR, while mitigating the negative impact of brackish water reverse osmosis.

The experimental activities at the Westland demo site have resulted in the following Foreground, (see also Deliverable D33.1):
- Conventional ASR in the typical Westland saline aquifer results in ASR recovery efficiencies <30%. This can increase to efficiencies >50% with the innovative well design and even more by the use of RO.
- The advanced ASRRO system showed capable of 1) enlarging the recovery of unmixed freshwater upon storage, 2) providing a more robust water supply thanks to the use of RO and 3) attaining a neutral water balance to prevent mining of water from a coastal aquifer.
- Clogging of membranes (and potentially: re-injection wells) during ASRRO appears to be driven by mobilization of clay particles and Fe-colloids. This can be mitigated by regular flushing of the RO-membranes with permeate and regular cleaning of the re-injection well.
- The impact of widespread use of ASRRO on the regional Westland groundwater system was lim ited based on regional groundwater modelling, but it was shown that ASRRO decreased the chloride concentration with respect to the autonomous scenario and the use of brackish water reverse osmosis (BWRO). ASRRO was successfull in mitigating the local negative impact (saltwater plume forma

tion) caused by the deep disposal of membrane concentrate during BWRO. An overall positive to neutral impact of ASRRO on a coastal groundwater system is presumed, which is an improvement with respect to the use of BWRO in the same setting. ASRRO thus provides means to more sustain able use of coastal groundwater systems.

Deliverable D33.2 shows that application of the advanced ASRRO system creates value for three types of ecosystem services (ESS):
- Availability of groundwater for irrigation (provisioning)
- Chemical water conditions (regulation and maintenance)
- Stormwater retention (regulation and maintenance)

If only the production is considered, ASR technology makes the production of irrigation water more expensive. When environmental effects are taken into account as well, ASR becomes a more compet itive option, even when measures are needed to filter out contaminants from the water that is injected. Under current policy, mitigation of environmental effects is not required, which is a reason why this technology is presently not used at most horticultural complexes in the region. Planned policy revi sions (2022) may however provide opportunities for wide scale application of this technology, al though subsurface spatial planning issues still need to be resolved. Further upscaling of the techno logy could be beneficial, especially if all groundwater abstraction is compensated for by injection of fresh water. Thus, it may potentially also reduce sea water intrusion that takes place along the coast line. At a larger scale application, complete compensation would be possible if companies with a low water demand inject more water than they abstract, to compensate for companies with a high water demand that abstract more than they inject. As such a system needs incentives; a water bank system is proposed as a measure to make the water use in the whole region more sustainable.

2.3.4 Sewer mining for urban re-use e.g. for irrigation of urban green (Athens – WP34)

A packaged plant consisting of an advanced Membrane Bioreactor coupled with ultra-filtration and reverse osmosis (MBR-RO) was installed in the EYDAP R&D department (KEREFYT);(M18 pro gress report). The installation, which is linked to the Metamorfosi WWTP, facilitates direct abstrac tion from main sewers and is able to accept multiple types of effluent (municipal and industrial). The Athens' pilot plant has been operating for more than two years, from 2015 until now (see also the previous progress reports). During the first year the operation of the unit was thoroughly examined so as, to fortify its stability and final effluent quality while in the second year the optimization of the unit with respect to several crucial parameters took place.

The results from the 2 years of unit's operation underpin that:
- the installed MBR-RO pilot unit can reclaim water of excellent quality which is in line with the stringent standards that are specified in the Greek National legislation regarding wastewater reuse for unrestricted irrigation and urban reuse.
- the system presented great stability, with the effluent quality being independent of the inlet's qualit ative fluctuations.

While, the optimization with respect to several parameters, such as, sludge retention time, hydraulic retention time, organic loading and the employment additives in combination with their impact as sessment on the system's performance regarding the final effluent quality, GHG emissions, energy demand and membrane fouling (M36 and M48 progress reports), highlight that (M48 progress report and D34.4):
- the use of additives reduced membrane fouling –as expected- but the reduction was not radical enough to justify the entrance of additives into the maintenance protocol.

- The optimal sludge retention time (SRT) is 20 days (as designed)
- The use of additives reduced membrane fouling –as expected- but the reduction was not radical enough to justify the entrance of additives into the maintenance protocol.

Furthermore, during the M36 reporting period, the monitoring and supervisory system of the unit has been fully developed, installed, tested and implemented. Subsequently, until M48 progress report its features has been improved and extended. The integrated SW and HW platform is collecting, pro cessing and visualizing data collected from the field sensors installed at the pilot area. The front-end and back-end of the ICT/Monitoring solution (also referred as Advanced Monitoring Infrastructure; AMI) have been implemented using a low-cost solution (small sized single board computer), adopt ing OGC standards supporting interoperability. The final solution offers a user-friendly cloud-based User Interface which are in accordance to modern computing development standards.

Finally, we conducted an economic analysis and evaluation of ESS. Its three main pillars are: (a) the estimation of water scarcity mitigation, (b) the valuation of water-enhanced ecosystem services (microclimate regulation) and (c) a discussion on derived economic activities as well as the business model for the sewer mining unit's sustainable operation in a market environment (see D34.3).

Its main results are (see M48 progress report and D34.3):
- Microclimate regulation benefits for a model household of 4 people (parents and 2 children) range between € 130-180 annually, depending on the sewer-mining unit's technology (MBR-UV or MBR-UV-RO).
- Groundwater scarcity cost mitigation ranges between € 0.40-0.50/m3, depending on the sewer-mining unit's technology (MBR-UV or MBR-UV-RO) and the cost reduction rate (learning curve) per year. Specifically, this is achieved for an average total cost reduction rate of the sewer-mining unit ranging from € 0.08-0.09/m3/year so that within the first five (5) years the major part of the scarcity cost will have been mitigated by both technologies.

2.3.5 A flexible ASR system to recharge different water qualities (Llobregat - WP35)

The experimental activities at the demo site in the Llobregat have resulted in the following Fore ground:
- Validation of sand filtered water as a pre-potable water type to be injected in Llobregat Delta aquifer
o Beginning with a preliminary study of sand filtered water characterization and a comparison with legal limits and international experience, continuing with a pilot column test and finishing with the injection in a real well, it was validated the suitability of sand filtered water of Sant Joan Despí Drinking Water Treatment Plant as injecting water in Llobregat Aquifer Storage and Recovery sys tem.

- Demonstration of the benefits of pre-potable water aquifer injection
o After the conditioning of existing network of observation wells and implementation of additional piping , during one year period it was injected a total of 0,6 Hm^3 of sand filtered water and it were monitored groundwater parameters (both physical and chemical) to study all the injection impacts.
o The advanced hydrogeochemical modelling of different scenarios, including demonstration phase (with calibration with real data) and full-scale implementation, allowed to demonstrate the impact of the recharge and served for ecosystem services evaluation

- Validation from ASR operator and administration of the applicability of the demonstrated innova tion

o Working side by side with the ASR operator (Aigües de Barcelona) and reaching agreements of the research plan with the administration, allowed the applicability of the results and its future transferability to a full-scale implementation

- Introduction of the concept of Managed Aquifer Safety plans as a methodology to be applicable to flexible ASR systems to other European sites
o With the experience gained in the demonstration phase and during the knowledge and results transfer to water administration and public health agency, it we developed (as a preliminary concept) a methodology .

- ESS application in demo site
o We assessed the beneficial effects of ASR technique in terms of ESS enhancement and studied the economic approach to include these services in a regulated payment system.

2.4 Work Area 4 – Bringing Innovation to Society and Market

Work Area 4 was mainly focused on developing public project correspondence and dissemination materials, establishing showcases at all demo-sites and maximising the market reach and impact of the solutions developed in WA1 and WA2 and demonstrated in WA3.

All the planned materials and tasks have been successfully developed and, in addition, extra materials have also been produced. These materials have served to reach all the defined objectives and to bring the innovation and the key results of the project to Society and Market, which was one of the main aims of this area.

2.4.1 Dissemination of DESSIN and development of its demo-sites as showcases (WP41)

All the promotional contents and dissemination materials produced within DESSIN are explained in detail in Deliverable D41.3.

Regarding Work Package 41, its key outcomes are:

2.4.1.1 Website news
The DESSIN website, developed within Task 41.2 (www.dessin-project.eu) serves as an information source for the DESSIN project and as a principal outlet of informational products about or coming from DESSIN, such as deliverables or the DESSIN newsletter and magazine.

The news section has been updated during the lifetime of the project with 94 posts, including interviews, deliverables, dissemination materials and achievements from the project or new milestones reached. This continuously updated blog on the DESSIN website (at least once a month) has served to keep the DESSIN external audiences informed about the project progress. Regarding the downloads section, it has been used to store different materials, such as DESSIN results, dissemination materials or the DESSIN Ecosystem Services Valuation Toolkit, among others.

Besides, an internal area was set up for the DESSIN members (internal audiences) to allow them to share their work in progress, and to be able to receive minutes, presentations, project templates, internal documents, among other things.
Apart from the website, during the lifetime of the project different promotional contents and dissemination materials have been produced:

2.4.1.2 Newsletter

The electronic newsletter is an online dissemination material that has served to communicate general information related to the project's demo-sites, the faces behind the project, the main progress of DESSIN and its most relevant milestones. During the lifetime of the project, 6 issues of the newslet ter have been produced and sent both to the project consortium and to the newsletter's subscribers, previously registered through DESSIN website.

All the newsletters have followed the same structure, sorted in 6 sections: Our demo sites, Interview, Success Story, ESS Section, DESSIN Marketplace, DESSIN achievements and Upcoming events.

2.4.1.3 Leaflet

As part of additional material not included in the proposal, WA4 produced a leaflet explaining the main points of the project. It is focused on offering a general overview of the project's context, ob jectives and the demo-sites, in order to serve as an informative material to discover DESSIN in gener al.

2.4.1.4 Annual Magazine

The Annual Magazine is an online material (can also be printed) explaining the progress and works of the project, without a regular structure. Nevertheless, each issue includes an interview to a relevant person related to the project and/or to ESS, the last news on the project, information about the ESS Evaluation Framework and the project partners. During the lifetime of the project, 4 issues of the An nual Magazine have been produced (2015, 2016, 2017 and Final Magazine). The Annual Magazine 2015 and 2016 were printed and distributed among the partners.

Figure 2 DESSIN final magazine

Besides, we published an additional issue of the Annual Magazine during the last month of the project. The so called Final Magazine is an online and printed material based on the Annual Magazine that gives an overview of the project context, objectives, the ESS Evaluation Framework and includes an explanation of the five demo-sites and its main results referring to Ecosystem Ser vices. It has been used for the final dissemination of the project to interested audiences and different stakeholders. In this case, 1.250 copies of the Final Magazine were printed and sent among the part ners, in order to be distributed among partners' stakeholders and interested groups. This issue was also delivered to the attendants of the DESSIN Final Workshop, held in Brussels on November 28th 2017 and the local workshop held in Barcelona on December 12th 2017.

2.4.1.5 ESS Evaluation Framework brochure

The ESS Evaluation Framework brochure was developed in order to explain the Ecosystem Services Evaluation Framework created by WA1. This material helps to draw the whole picture of the frame work, especially to non-especialised audiences. The brochure was printed and delivered among the project partners and the attendants to the DESSIN Final Workshop.

2.4.1.6 Press release

A press release on ESS Evalutarion Framework was sent to different media channels in order to in form on the creation of the ESS Evaluation Framework.

2.4.1.7 Final Video

The DESSIN video is the main material for future dissemination. It was produced during the last months of the project and serves to show the context, the objectives and the research developed with in the project, as the ESS concept and the ESS Evaluation Framework, to a general and non-specialised audience.

Two versions of the video were produced:
· Long version: this version includes an explanation of the solution demonstrated at each demo-site and the main results obtained.
· Short version: the short version only offers a general overview of the project context, objectives and main results. This version has been produced for online distribution through online channels, such as social media.

2.4.1.8 Re-usable illustrations
A pack of re-usable illustrations has been produced to help disseminating the project. Those images and graphics serve to ease the comprehension of some of the DESSIN technologies, systems and pro cesses and can be used in different types of communication and dissemination materials, both printed and online.

2.4.1.9 Policy Briefs
DESSIN produced a set of policy briefs in collaboration between WP12 and WP41. These briefs provide a series of five recommendations on governance design factors conducive to innovation up take. Both are targeted to water managers and policy makers, aiming to create enabling environments for innovation uptake.

Those documents are available in DESSIN website:
• DESSIN Policy Brief #1: Good Practice in Urban Water Management: Designing governance and financing regimes to encourage innovation uptake.
• DESSIN Policy Brief #2: Good Practice in Urban Water Management: Increasing chances of innov ation uptake through governance.

2.4.1.10 Showcases
Regarding Task 41.4, during the lifetime of the project, in each of the DESSIN demonstration sites showcases have been successfully developed and established. Each showcase was set up in a distinct way, reflecting the local conditions, target audiences and wishes. The overall objective of the show cases is to promote the uptake of the innovative solutions enhancing ecosystem service, developed in DESSIN, and show relevant stakeholders, authorities, decision makers, researchers and the general public their potential. The showcases also provide a playground for new technologies to be demon strated in a real life environment. The showcases had a clear role during the DESSIN project, but we also foresee active showcases beyond the DESSIN lifetime to endorse the uptake of the innovative solutions. In Deliverable D41.4, the established showcases at demo-sites are explained in detail.

The Emscher showcase consists of three movies describing how innovative technological solutions help improve ecosystem service provision in dense urban areas. The three movies focus on (1) the Emscher area and its reconversion and restoration process going along with water quality challenges, (2) the demonstration of a decentral treatment of combined sewer overflow via a lamella settler solu tion, and (3) the demonstration of a Real Time Control system via the ADESBA solution.

The Westland demonstration site was developed into a fully functioning showcase. The showcase in cludes a guided tour along the different objects of the facilities at the demo site, a mobile banner ex position of the different technologies applied at the site, and also promotes and enables testing of in novative technologies, equipment and methodologies. The Westland showcase is located within the facilities of the Prominent Innovation Centre in Gravezande in the Westland, the large greenhouse area between the cities of The Hague and Rotterdam (Greenport Westland). This showcase also con sists of a video explaining the solutions tested and developed in this demo-site.

The Hoffselva showcase consists of the demonstration site (inlcuding information boards) and activit ies and means for spreading information about the technologies, the ESS evaluation and the DESSIN project, and dissemination of results from the demonstrations. This showcase also consists of a movie explaining the demo-site and the demonstrated solutions in Hoffselva river within DESSIN.

The Athens showcase acts as demo facility for water innovations. The Athens showcase supports on-site visits, by developing an information board, leaflets, targeted presentations and a dedicated web site, as well as dissemination material including an animated movie showing the concept and benefits of sewer mining to potential target groups.

The demo site at Llobregat is located at the drinking water treatment plant (DWTP) facilities Sant Joan Despí and is easily accessible for all visitors of the water company, which supports the develop ment of a DESSIN showcase. The showcase includes a.o. a notice board, a digital totem, on-site vis its and an animated movie explaining the concept of pre-potable water injection into aquifers.

2.4.2 Route to Market (WP42)

The overall objective of Work Package 42 was to maximise the market reach and impact of innovat ive water technologies developed in work area one and two and demonstrated in work area three. As part of this commercialisation process, a sample commercialisation approach for innovative water technologies that relate to water-based ESSs was devised.

The process comprised the following key results:
1) Business Environment Analysis (D42.3): DESSIN's commercialisation activities were com menced with an assessment of the business environment in the form of two outside-in reports which consider the wider market picture and determine opportunities and market risks for ESS-related in novations in the water sector. Both reports provide a wider market overview for innovations linked to water quality-related ESSs and analyse the general market for the respective DESSIN solution pack age.
a) Report on water scarcity (Llobregat, Spain)
b) Report on water quality (Emscher, Germany)
2) Market analysis (D42.1): Individual customised reports for SMEs (SME point of view) with re commendations on how to enter a specific market. The documents serve as a guidance document for SMEs.
3) Monitoring and Evaluation Platform (D42.5): For keeping track of both, supporting and impeding conditions for commercialisation of innovative technologies that improve water-related ESSs. The M&E system is an indicator-based tool for a rapid preliminary multi-dimensional market assessment and follows a three step approach on (1) product readiness, (2) potential target markets and (3) ex ternal framework conditions (e.g. general market conditions, governance frameworks and finance). Based on the assessment, a suitability ranking of prospective target markets is created and the most promising market highlighted. The assessment thus fosters the update of ESS-relevant innovations by providing a tangible tool for SMEs that is publicly accessible via https://dessin.adelphi.de/
4) Capacity Building and Training of SMEs (D42.2 plus 6 workshops): Various capacity building and training activities were conducted in order to provide individual support to DESSIN SMEs. Core of the capacity building and training activities were customised training workshops during which sample runs of the commercialisation strategies were discussed with each SME. Finally, all DESSIN SMEs were brought together for a peer-to-peer learning workshop.
5) Lobbying for ESSs valuation and assessment of modes of interaction: ESSs valuation as promoted among various stakeholders and decision makers in the water sector (participation in conferences and

organisation of several workshops).
6) Promotion of Innovations Based on water-related ESS: SMEs were brought together and were jointly represented at existing dialogue forums e.g. EIP action groups, WssTp and ERRIN in order to foster an enabling business environment. ESSs lobbying was continued through promotion of DESSIN solutions among policy makers and prospective end-users at a national and international level.
7) Strategy paper (D42.4): Based on the previously explained activities and results, a strategy was prepared that covers aspects pertaining to the marketization of the proposed ESS valuation methodo logy within the European Union (with a particular focus on Germany and the Netherlands).

Potential impact and main dissemination activities and exploitation results

3 Potential impact

3.1 Overview

At all demonstration sites, follow-up activities are in full swing. They are very diverse in nature and extent, but range from continued testing to full-scale implementation, replication and even regional roll-out.

More details are given in sections 3.2 to 3.5, but here is a summary of some highlights:

• The DESSIN team has published the ESS evaluation framework in a key journal for of the "Ecosystem Services" scientific community.

• Beneficiaries who have branches active in consulting (such as Ecologic, IWW, adelphi) will use the ESS valuation methodology in their consulting services for the water sector, to facilitate cost-benefit analysis and enable better and more transparent decision-making.

• Beneficiary DHI has transformed the ESS framework into a software module that is now part of an overarching software suite (MIKE) offered by DHI internationally. DHI will further pursue the com mercialization. Whilst the basic (and fully functional) version of the software is freely available, there will also be an extended version with additional features such as an indicator manager and the ability to run simulation models within the tool.

• Beneficiary UFT has already started a commercial follow-up of the lamella settler solution from WP21/WP31: a cross-flow settler built in Eutingen (Southern Germany).

• Beneficiary SEGNO is aiming to build a reference business case with ADESBA. To this aim, SEGNO has already held a joint workshop with the case owner, Emschergenossenschaft. The priority will be to first approach the German-speaking countries where references with existing regulations and guidelines are already tested and known. Afterwards, SEGNO aims at approaching the rest of the European market.

• Beneficiary Inrigo is currently promoting the first installation of man-hole type high rate filtration (HRF) system (WP21/WP32) in one of the several Norwegian municipalities who showed interest in this technology for local CSO control.

• Demonstration of the effects and costs of ASRRO at the Westland site has supported convincing other individual greenhouse owners to implement ASR or ASRRO on their plots: around 11 ASRRO wells have been built since 2015 and around 12 are in the final design phase, which will result in an

estimated turn-over for SME's of over 3.0 M€. Beneficiary KWR and Dutch engineering consultant Arcadis have set-up a Public-Private Partnership (Allied Waters, Collab SALutions) to bring the knowledge to market (staffed by 2-3 fte in 2018).

• The sewer mining solution from Athens (WP34) has won a European Business Award; the demon stration will run at least one more year beyond DESSIN. Replication has started by installment of a similar unit in the Natura protected area of Schinias, Greece; the installation of a full-scale unit in an urban area of Elaionas has been authorized.

• Linked third party Aigües de Barcelona (demo site owner) is willing to apply the Aquifer Storage and Recovery system from WP35 in real scale in 2020/2021, when the facility will be prepared and the public authorities have granted the permit.

• All sites have been transformed into local showcases, some with a focus on educational material (e.g. videos), others even with walkable routes among the installation, permanent information boards and local on-site events with pupils, students, and other target groups.

3.2 The Ecosystem Services Evaluation Framework (WA 1)

Results from Work Area 1 have been and continue to be disseminated through various external chan nels since early on in the project. These include scientific publications like Getting into the water with the Ecosystem Services Approach: the DESSIN ESS Evaluation Framework by Anzaldua et al., published open access in the Elsevier "Ecosystem Services" journal in 2018; Governance Regime Factors Conducive to Innovation Uptake in Urban Water Management: Experiences from Europe by Rouillard et al., published open access in the MDPI journal "Water" in 2016; and Large-scale river restoration pays off: A case study of ecosystem service valuation for the Emscher restoration genera tion project by Gerner et al., submitted to the Elsevier "Ecosystem Services" journal in 2017; among others.

Outputs have also been showcased in a dedicated post in The Freshwater blog (www.freshwaterblog.net) as well as presentations and sessions in conferences inter alia the European Ecosystem Services Conference in Antwerp, BE in 2016 and the Nature based solutions & Urban Agenda Conference in Utrecht, NL also in 2016. Regarding the outreach to the industry and practicioners community the results from Work Area 1 have been presented in the technical publica tion Promoting Innovation Through The Assessment Of Changes In Fresh Water Ecosystem Ser vices: The DESSIN ESS Evaluation Framework by Anzaldua et al., published in the German Americ an Water Technology Magazine in 2015; at the yearly European Innovation Partnership on Water event in Leeuwarden, NL in 2016 and in a dedicated webinar for the Ecosystem Services Working Group of the WssTP in 2016.

Internal exploitation of the results was ensured through the design of the project's work plan (e.g. ap plication of the DESSIN ESS Evaluation Framework on the demo sites) and was actively pursued beyond the project via collaborations with other European Research projects like OpenNESS, MARS, AQUACROSS and SHEBA, through implementation of the ESS framework in several PhD studies and its inclusion as a key element in new European research project proposals.

The potential policy applications of the DESSIN ESS Evaluation Framework as a tested integrative assessment are various and particularly relevant for the revision of the WFD, for instance to inform the design of new status indicators suitable for the evaluation of WFD Programmes of Measures. Fur ther, the Work Area 1 team is exploring the link between ESS and the Sustainable Development

Goals (SDGs) with the aim of framing DESSIN ESS evaluation results under the objectives of inter alia SDG6: Ensure availability and sustainable management of water and sanitation for all, SDG8: Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all, and SDG12: Ensure sustainable consumption and production patterns.

As stated earlier, the results from ESS evaluations using the DESSIN framework have great potential to supplement large EU-scale ESS assessments and be taken up by e.g. WG MAES, particularly for the ex-post assessment of management options for ecosystem restoration and biodiversity protection and conservation.

3.3 Technology solutions developed (WA 2)

3.3.1 Water quality technologies (WP21)

3.3.1.1 Enhancing treatment efficiency in CSO holding tanks with cross-flow lamella settlers (WP21.1)
Beneficiary UFT has already started a commercial follow-up of the lamella settler solution from WP21/WP31: it has further developed the cross-flow lamella settler type used in DESSIN and now introduced it to the market. UFT has now built a commercial full-scale plant in Eutingen (Southern Germany). Hence, this is a good example of a replication and trans-regional transfer of a solution demonstrated in DESSIN and taken to the next level of commercialisation by the beneficiary, a SME.

3.3.1.2 Local treatment of CSO overflow by High Rate Filtration (WP21.2)
The potential value of reduced discharges from CSO for beneficiaries is substantial. It relates both to Regulation & Maintenance and to Cultural ESS. Considering the direct effects of the demonstrated solutions, the Cultural ESS associated with aesthetic appreciation of the river water itself and riverb ank area, i.e. ESS associated to transparency of the river water, and visual impression of water and ri verbank, were selected as Final ESS. Inrigo is currently promoting the first installation of man-hole type high rate filtration (HRF) system in one of the several Norwegian municipalities who showed in terest in this technology for local CSO control.

3.3.1.3 Reducing CSO overflow volumes by Real Time Control (WP21.4)
The first priority of SEGNO after DESSIN is to build a reference business case with ADESBA. To this aim, SEGNO has already held a joint workshop with the case owner, Emscher Genossenschaft. The aim is to roll out ADESBA in the area of Emscher and use the business case for further market ing campaigns. The priority will be to first approach the German-speaking countries where references with existing regulations and guidelines are already tested and known. Afterwards, SEGNO aims at approaching the rest of the European market.

3.3.2 Water scarcity technologies (WP22)

3.3.2.1 Distributed reuse through sewer-mining in large urban areas (WP21.1)
The DESSIN's Athens pilot developed and demonstrated an innovative decentralized and modular solution for urban water use. The solution consists of a compact sewer mining (SM) unit enabled by advanced monitoring infrastructure. The results obtained from the pilot indicate the potential of the technology to provide reclaimed water at low-cost (0.86-1.07€/m3) and simultaneously reliably meet all the national and international criteria set for all types of non-potable wastewater reuse.

The solution has won EYDAP and its partner institutions (the Athens' water supply and sewage com pany - and a project partner) two awards in the European Business Awards for the Environment

(EBAE) in two categories the Products & Services and the Business & Biodiversity. As a follow up to this, EYDAP, with the support of its partner institution NTUA, decided to prolong the operation of the Athens pilot for at least one more year aiming at conducting further piloting to assist upscaling and promote full scale applications.

Finally, the Athens solution has triggered further innovation development, as it allowed NTUA to ob tain the permit to install a similar unit in the Natura protected area of Schinias, Greece. It also motiv ated the municipality of Athens to participate in a new H2020 project, called NextGen and authorize the installation of a full-scale SM unit in the urban area of Elaionas, Athens, Greece.

3.3.2.2 ASRRO for saline or brackish aquifers (WP22.2)
Based on the results of WP22.1, the potential, essential guidelines, and pitfalls for the use of ASRRO were quantified. The impact of this is that in current application of aquifer storage and recovery, the optimal set-up of the ASRRO based on the Westland site is taken up in the design phase and in the regional planning of water supply measures.

Two most relevant examples:

• The Glasparel+ area: around 100 hectares of greenhouses currently under development in the Wad dinxveen area. The basis of their water supply was mend to be aquifer storage and recovery (ASR) of local rainwater in a brackish aquifer. However, in dry years, ASR was predicted to be insufficient. During the final design phase, the ASR was transformed to ASRRO with approval by authorities. The construction phase is planned for 2018 and results in a turn-over for SMEs (construction and en gineering firms) of around 2.0 Me;

• The ASRRO is considered a solution on the regional scale of the Westland area. In this set-up, ASR and RO are combined over the whole extent of the Westland area in order to balance freshwater ab straction and replenishment of the aquifer, while maintaining the guarantee of a high quality freshwa ter source (thanks to RO-treatment) and complying with groundwater quality aims. This was suppor ted by the modelling performed in WP33. The estimated resulting turn-over for SME's for realizing these regional adaption strategy using ASRRO is more than 29.0 Me.

3.3.2.3 Increased flexibility and resilience of Aquifer Storage and Recovery in strategic groundwater reservoirs (WP22.3)
Amphos 21 has contributed to WA 2 of DESSIN by developing a software tool to evaluate all water interactions when applying a MAR system in a typical and generic coastal deltaic aquifer. The aim was to provide a tool to quantify the impacts of the technique in a general view and to help to over come implementation barriers related to the difficulty of showing the benefits of the technology to non-experts. At the same time these impacts could be related with ESS changes and quantified using economic valuation.

As result from the modelling results and consequent demonstration, the local authorities are motiv ated to further study the potential of full scale application of pre-potable water injection schemes to secure water supply

3.3.3 Software framework for ESS valuation (WP23)

The DESSIN software tool developed to assist with implementation of the DESSIN ESS evaluation framework and sustainability assessment developed in WP23 provides water utilities with additional inputs to the traditional evaluations of alternatives solutions. It enhances the capability to distinguish

the most effective and efficient solutions as more informed decision making and in turn promote in novation and competitiveness in the water sector because it provides economic arguments for the im plementation of innovative solutions.

The software tool will continue to be available to the public after the conclusion of the project. DHI will support the tool and will make it available for free as part of its MIKE OPERATIONS software package. DHI hope that others outside the DESSIN consortium will use the tool to support ESS as sessments and integrate ESS values into the cost-benefit analysis of proposed projects and measures.

3.4 Demonstrated solutions (WA 3)

The key aspects regarding (potential) impacts, dissemination and exploitation from the DESSIN demonstrations are closely related to those outlined for WA 2 in chapter 3.3, because these two Work Areas were forming a logical sequence: RTD activities in WA 2 prepared and supported the actual demonstration of technologies in the real environment settings of WA 3. However, the actual demon stration of the solutions and the assessment of their benefits and co-benefits (through the ESS evalu ation framework developed in WA 1) yield a more detailed and specific perspective.

The key features with a high potential impact from WA3 are as follows (for more details see sections 3.4.1 to 3.4.5):

- Emscher demonstration (WP31): Potential for application of demonstrated innovative technologies (lamella settler, RTC) by the water boards Emschergenossenschaft and Lippeverband, especially to adapt existing water infrastructures to climatic and demographic changes in the future. Continuation of ongoing ADESBA-RTC operation and potential for extention by including further CSO facilities into the RTC system.

- Hoffselva demonstration (WP 32): Potential for application of proven innovative technologies (HRF, CLS) by water utilities (Oslo VAV) to adapt their water infrastructures to climatic and other future changes.

- Westland demonstration (WP33): Successful replication of ASRRO on other sites to secure high quality freshwater supply has created business opportunities for SMEs; setup of PPP with KWR as partner aims to stimulate large scale application of subsurface water solutions in coastal regions worldwide.

- Athens demonstration (WP34): Upscaling of the sewer mining demonstration into full scale, “real-world” applications is foreseen through active co-operation between the water utility (EYDAP) and NTUA. This may potentially result in business opportunities for SMEs providing technologies as well as services.

- Llobregat demonstration (WP35): positive decision taken by water utility and local authorites to fur ther study the potential of full scale application of pre-potable water injection schemes to secure wa ter supply.

3.4.1 Improving water quality in a highly urbanized area (Emscher – WP31)

A reduction of combined sewer discharges from CSO facilities is of great benefit for the water boards Emschergenossenschaft and Lippeverband who are managing the river basins of Emscher and Lippe river. As demonstrated and disussed, the two tested technologies have the potential to improve both

Regulation & Maintenance and Cultural ESS. Especially for adaptation of existing water infrastruc ture and planning of new facilities with regard to future challenges (climatic and demographic), the DESSIN ESS and SA approaches can extend the scope of the current practice of evaluations of al ternatives.

EG, with the support of its partner institution SEGNO, plans to further engage in the RTC technology implemented in DESSIN. It is planned to continue the operation of the Emscher RTC pilot for at least one more year, conducting further research regarding its efficiency and upscaling to sub-basin level. Similarly, it is planned to identify a possible second pilot site for testing the cross-flow lamella settler using different combined sewage with different types of particles, as the efficiency results obtained in DESSIN need to be validated at an additional site with distinct sewage conditions. This is to be con ducted with support of our partner UFT and with the aim of future full-scale application in suitable existing or planned CSO facilities in which particle concentration needs to be minimized.

To disseminate the two demonstrated technologies, three short movies have been developed: a gener al movie on the challenge of CSO concerning water quality, a movie on the cross-flow lamella settler solution and a movie on the ADESBA RTC solution. The movies have been placed in the EG, UFT and SEGNO websites and are available for presentation at fairs and meetings. Furthermore, a large number of presentations has been given at EG internal, regional, national and international confer ences and meetings, disseminating the DESSIN results.

The DESSIN ESS framework and the SA represent tools that can be applied to evaluate options of measures and decide for the best alternative in terms of ESS and sustainability. A simplified SA is already in use for important decisions at Emschergenossenschaft. Furthermore, the benefit assessed in the ESS evaluation of the Emscher reconversion is already widely used and presented at EG intern al and external meetings.

3.4.2 Improving water quality in a peri-urban area (Hoffselva – WP32)

The potential value of reduced discharges from CSO for beneficiaries is substantial. It relates both to Regulation & Maintenance and to Cultural ESS. Considering the direct effects of the demonstrated solutions, the Cultural ESS associated with aesthetic appreciation of the river water itself and riverb ank area, i.e. ESS associated to transparency of the river water, and visual impression of water and ri verbank, were selected as Final ESS.

The solutions demonstrated in DESSIN may be additions to the 'toolbox' of alternative measures that Oslo VAV may use in assessing options for future adaptation of the water infrastructure, and the DESSIN ESS and SA methodologies may give additional inputs to the traditional evaluations of al ternatives.

3.4.3 Freshwater supply for horticulture from brackish aquifers (Westland – WP33)

Thanks to the transformation of the Westland Demo site to a showcase (including information panels, accessibility, scale models, information video), over 500 people from over 20 different countries vis ited the Westland demo site during the DESSIN lifetime. Since then, several initiatives have taken off to store different water sources in similar ways, such as treated waste water (reuse), urban storm water (Rotterdam), surface water, and drainage water.

Demonstration of the effects and costs of ASRRO at the Westland site has supported convincing oth er individual greenhouse owners to implement ASR or ASRRO on their plots: around 11 ASRRO

wells have been built since 2015 and around 12 are in the final design phase, which will result in an estimated turn-over for SME's of over 3.0 M€.

Inspired by the succes of ASRRO as an example of a subsurface water solution, KWR and Dutch en gineering consultant Arcadis have set-up a Public-Private Partnership (Allied Waters, Collab SALu tions) to bring the knowledge to market. By 2018, this collab is staffed by 2-3 fte.

3.4.4 Sewer mining for urban re-use e.g. for irrigation of urban green (Athens – WP34)

The experimental results from the Athens demonstration: Sewer Mining for Urban Re-use enabled byAdvanced Monitoring Infrastructure (AMI), indicate that the implementation of an on-site compact treatment system consisting of a pre-treatment unit followed by a membrane bioreactor and finally a UV unit for disinfection can reliably meet all the national and international criteria set for all types of non-potable wastewater reuse (see D34.3). This in combination with the AMI facilitates a novel de centralized, modular and economically-feasible solution for water recovery for non-potable uses. Un doubtedly, this innovative solution paves the way for large-scale low footprint, water reuse adapta tion, thus saving fresh water, in highly urbanized, space-limited environments (objectives in accord ance to DOW).

Building on the conducted economic evaluation and the identified scale-dependent business models for the optimal diffusion and operation of the sewer-mining technology in a market environment it can be argued that the public-private partnership model can be considered to be more flexible for both the small and the large-scale (see D34.3). Nevertheless, irrespective of the business model selec tion and the area's scale, it is expected that in any case the increase of water availability due to the in stallation of a sewer-mining unit could lead to significant enrichment of economic activities in the area as well as enhancement of existing ones. The majority of these new activities could relate to tourism (eg. for the Athens case, increased number of arrivals due to the upgrade of "green" environ mental state, more visits to a nearby archaeological site, environmental education activities, small-scale bio-culture and generally better value-for-money per unit of visit).

According to the above elements, a major potential for the commercial diffusion of the sewer-mining technology is the creation of local markets. In particular, these markets can take the form of real-time or programmed contract-based exchanges of recycled water or useful materials for stakeholders. This prospect becomes of higher importance as the scale of the area increases and more stakeholders are involved, making the need for an organized information system on supply and demand more critical. As far as future exploitation and exploitation of the results obtained through DESSIN, EYDAP, with the support of its partner institution NTUA, plans to further engage in the technologies implemented in the projectand thus support the operation of the Athens pilot plant for at least one more year aim ing at conducting further research regarding its upscaling uptake for full scale, "real-world" applica tions. Furthermore, during this period more dissemination activities will be realized through work shops and meetings with other stakeholders, e.g. municipal water supply and sewage companies. Moreover, an additional plan aims at utilizing the effluent water in to the direction of upgrading the current R&D facilities into a low footprint, "green" establishment, propagating in this way the poten tial of the unit in making a step towards a sustainable, circular economy.

3.4.5 A flexible ASR system to recharge different water qualities (Llobregat – WP35)

Main achievement of DESSIN was the acceptance of the applied technology by the facility operator (Aigües de Barcelona) and administration authority (Water Catalan Agency). This has resulted in a willingness to implement injection of pre-potable water at full scale; From 2020/2021 onwards poten

tially 15 Hm³/year of pre-potable water can be injected, reducing costs by around 1M€/year with re spect to previous potable water injection.

3.5 Bringing Innovation to Society and Market (WA 4)

Work Area 4 did not produce results with a potential impact of its own, we rather designed it as a support module to bundle and facilitate project activities related to dissemination, exploitation and route to market.

3.5.1 Dissemination of DESSIN and development of its demo-sites as showcases (WP41)

Regarding the dissemination of DESSIN, the materials produced by WP41 serve to communicate the project results to target audiences and maximize its impact. The maintenance of DESSIN website is key to keep updating the interested audiences with news on the project outcomes and results, dissem ination activities and future applications.

On the other hand, the distribution of online and printed communication materials, such as the DESSIN leaflet, the Final Magazine or the ESS Evaluation Framework Brochure helps to dissemin ate general information on the project and its main results, mainly focused on Ecosystem Services, to target audiences, such as local stakeholders, administration or decision makers.

Likewise, DESSIN Final Videos, both long and short versions, are one of the most relevant dissemin ation outcomes, as they compile all the information related to the project and offer a general over view on the project objectives, progress and results. Their online distribution is a powerful way to reach different types of audiences, including general public, in order to raise the awareness on the concept of Ecosystem Services.

Finally, the established showcases serve to promote the uptake of the innovative solutions enhancing ecosystem service, developed in DESSIN, and show different audiences, such as relevant stakehold ers, authorities, decision makers, researchers and the general public their potential.

3.5.2 Route to Market (WP42)

Work package 42 maximised the market reach and impact of innovative water technologies by ad dressing two specific aspects namely the demand for innovative water technologies as well as the ca pacity of SMEs to serve the demand.

Demand was stimulated by extensive promotion of DESSIN technologies on international confer ences as well as workshops with important decision makers from the water sector. On the other hand, adelphi capacitated small SMEs from the water sector to identify and react to demand and generate business opportunities through the application of sustainable technologies that are based on ecosys tem services.

Adelphi’s key capacity building efforts were SME workshops as well as the creation of an online platform to assess and rank various countries for introduction of innovative water technologies. The online Monitoring and Evaluation platform is freely accessible and has been disseminated and pro moted on international conferences and workshops.

Address of project public website and relevant contact details

The public website is http://dessin-project.eu

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4.2 Use and dissemination of foreground

Section A (public)

Publications

LIST OF SCIENTIFIC PUBLICATIONS, STARTING WITH THE MOST IMPORTANT ONES										
No.	Title / DOI	Main author	Title of the periodical or the series	Number, date or frequency	Publisher	Place of publication	Date of publication	Relevant pages	Is open access provided to this publication ?	Type
1	Getting into the water with the Ecosystem Services Approach: The DESSIN ESS evaluation framework https://doi.org/10.1016/j.ecoser.2017.12.004	Gerardo Anzaldua , Nadine V. Gerner , Manuel Lago , Katrina Abhold , Mandy Hinzmann , Sarah Beyer , Caroline Winking , Niels Riegels , Jørgen Krogsgaard Jensen , Montserrat Termes , Jaume Amorós , Kristina Wencki , Clemens Strehl , Rita Ugarelli , Marius Hasenheit , Issa Nafo , Marta Hernandez , Ester Vilanova , Sigrid Damman , Stijn Brouwer , Josselin	Ecosystem Services	1	Elsevier	Netherlands	01/01/2018	in press	Yes	Peer reviewed

		Rouillard , David Schwesig , Sebastian Birk								
2	Governance Regime Factors Conducive to Innovation Uptake in Urban Water Management: Experiences from Europe 10.3390/w8100477	Josselin Rouillard , Rodrigo Vidaurre , Stijn Brouwer , Sigrid Damman , Alberto Ponce , Nadine Gerner , Niels Riegels , Montserrat Termes	Proceedings MDPI Journal	Vol. 8/Issue 12	MDPI (Multidisciplinary Digital Publishing Institute)	Switzerland	01/12/2016	477	Yes	Peer reviewed
3	Evaluation of Clogging during Sand-Filtered Surface Water Injection for Aquifer Storage and Recovery (ASR): Pilot Experiment in the Llobregat Delta (Barcelona, Spain) 10.3390/w9040263	Pere Camprovin , Marta Hernández , Sonia Fernández , Jordi Martín-Alonso , Belén Galofré , José Mesa	Water	Vol. 9/Issue 4	MDPI AG	Switzerland	01/04/2017	263	Yes	Peer reviewed
4	Consequences and mitigation of saltwater intrusion induced by short-circuiting during aquifer storage and recovery in a coastal subsurface 10.5194/hess-21-1173-2017	Koen Gerardus Zuurbier , Pieter Jan Stuyfzand	Hydrology and Earth System Sciences	Vol. 21/Issue 2	European Geosciences Union		01/01/2017	1173-1188	Yes	Peer reviewed
5	Large-scale river restoration pays off: A case study of ecosystem service valuation for the Emscher restoration generation project.	Gerner, N. V., Nafo, I., Winking, C., Wencki, K., Strehl, C., Wortberg, T., Niemann, A., Anzaldua, G., Lago, M., Bi rk, S.	Ecosystem Services	final decision pending	Elsevier		30/06/2018	estimated date	Yes	Peer reviewed
6	Reactive transport impacts on recovered freshwater quality during multiple partially penetrating wells (MPPW-)ASR in a brackish heterogeneous aquifer	Koen G. Zuurbier , Niels Hartog , Pieter J. Stuyfzand	Applied Geochemistry	Vol. 71	Elsevier Limited	United Kingdom	01/08/2016	35-47	Yes	Peer reviewed

7	How Subsurface Water Technologies (SWT) can Provide Robust, Effective, and Cost-Efficient Solutions for Freshwater Management in Coastal Zones	Koen G. Zuurbier , Klaasjan J. Raat , Marcel Paalman , Ate T. Oosterhof , Pieter J. Stuyfzand	Water Resources Management	Vol. 31/Issue 2	Springer Netherlands	Netherlands	01/01/2017	671-687	Yes	Peer reviewed
8	The Impact of Integrated Aquifer Storage and Recovery and Brackish Water Reverse Osmosis (ASRRO) on a Coastal Groundwater System 10.3390/w9040273	Steven Eugenius Marinjus Ros , Koen Gerardus Zuurbier	Water	Vol. 9/Issue 12	MDPI AG	Switzerland	12/04/2017	273-292	Yes	Peer reviewed
9	A Monte-Carlo-Based Method for the Optimal Placement and Operation Scheduling of Sewer Mining Units in Urban Wastewater Networks 10.3390/w10020200	Eleftheria Psarrou , Ioannis Tsoukalas , Christos Makropoulos	Water	Vol. 10/Issue 2	MDPI AG	Switzerland	13/02/2018	200-222	Yes	Peer reviewed
10	Sewer-mining: A water reuse option supporting circular economy, public service provision and entrepreneurship 10.1016/j.jenvman.2017.07.026	C. Makropoulos , E. Rozos , I. Tsoukalas , A. Plevri , G. Karakatsanis , L. Karagiannidis , E. Makri , C. Lioumis , C. Noutsopoulos , D. Mamais , C. Rippis , E. Lytras	Journal of Environmental Management	in press	Academic Press Inc.	United States	01/07/2017	in press	Yes	Peer reviewed
11	Turning black into green: ecosystem services from treated wastewater 10.5004/dwt.2017.20926	E. Rozos , I. Tsoukalas , K. Ripis , E. Smeti , C. Makropoulos	Desalination and Water Treatment	Vol. 91	Desalination Publications		01/01/2017	198-205	Yes	Peer reviewed
12	Identification of potential sewer mining locations: a Monte-Carlo based approach 10.2166/wst.2017.487	I. K. Tsoukalas , C. K. Makropoulos , S. N. Michas	Water Science and Technology	Vol. 76/Issue 12	IWA Publishing	United Kingdom	13/12/2017	3351-3357	Yes	Peer reviewed
13	Promoting on-site urban wastewater reuse through MBR-RO treatment 10.5004/dwt.2017.20804	A. Plevri , D. Mamais , C. Noutsopoulos	Desalination and Water Treatment	Vol. 91	Desalination Publications		01/01/2017	2-11	Yes	Peer reviewed

		, C. Makropoulos , A. Andreadakis , K. Rippis , E. Smeti , E. Lytras , C. Lioumis								

LIST OF DISSEMINATION ACTIVITIES								
No.	Type of activities	Main Leader	Title	Date	Place	Type of audience	Size of audience	Countries addressed
1	Oral presentation to a scientific event	AMPHOS 21 CONSULTING SL	Technical workshop: Water and R&D	02/04/2014	Madrid (Spain)	Scientific community (higher education, Research) - Industry	200	Spain
2	Oral presentation to a scientific event	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Workshop on joint and coordinated use of surface water and groundwater	14/05/2014	Cornellà de Llobregat (Spain)	Scientific community (higher education, Research) - Policy makers	70	Spain
3	Oral presentation to a scientific event	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Iberian Conference on hydrogeology	08/09/2014	Valencia (Spain)	Scientific community (higher education, Research) - Policy makers	200	Spain, Portugal
4	Oral presentation to a scientific event	KWR WATER B.V.	Vietnam Delegation (Vice Minister Agricultural and Rural Development)	17/09/2014	Gravenzande (Netherlands)	Policy makers	25	Netherlands, International
5	Oral presentation to a scientific event	KWR WATER B.V.	Deltas in times of climate change. 2nd international conference	24/09/2014	Rotterdam (Netherlands)	Scientific community (higher education, Research) - Policy makers	1200	Netherlands, International
6	Oral presentation to a scientific event	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	EIP Water Conference	04/11/2014	Barcelona (Spain)	Scientific community (higher education, Research) - Industry	30	Spain
7	Exhibitions	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Technical visit to the drinking water treatment plant and local DESSIN demo site	14/11/2014	Barcelona (Spain)	Industry	30	Spain
8	Exhibitions	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Networking visit (Catalonia - Pyrénées Orientales)	18/12/2014	Sant Joan Despí DWTP Barcelona (Spain)	Industry	19	France

9	Posters	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATUNGS-UND ENTWICKLUNGS GESELLSCHAFT MBH	Five DESSIN Posters at the International Conference IWA Cities of the Future -Transitions to the Urban Water Services of Tomorrow (TRUST)	28/04/2014	Mülheim an der Ruhr (Germany)	Scientific community (higher education, Research)	150	International
10	Oral presentation to a scientific event	KWR WATER B.V.	IAHR-World Congress	01/07/2015	The Hague (Netherlands)	Scientific community (higher education, Research)	120	50 different countries
11	Exhibitions	KWR WATER B.V.	Showcase Water buffers Netherlands	28/08/2015	Gravenzande (Netherlands)	Scientific community (higher education, Research) - Industry - Policy makers	85	Netherlands
12	Oral presentation to a scientific event	KWR WATER B.V.	PvdA Network	09/10/2015	Gravenzande (Netherlands)	Policy makers	25	Netherlands
13	Oral presentation to a scientific event	KWR WATER B.V.	Subsoil	09/10/2015	Nieuwegein (Netherlands)	Scientific community (higher education, Research)	45	Netherlands, Germany, Denmark, Greece
14	Oral presentation to a scientific event	KWR WATER B.V.	Students University Amsterdam	27/10/2015	Amsterdam	Scientific community (higher education, Research)	24	Netherlands
15	Oral presentation to a scientific event	KWR WATER B.V.	Water community Municipality Westland	10/11/2015	Westland (Netherlands)	Policy makers	20	Netherlands
16	Oral presentation to a scientific event	KWR WATER B.V.	Municipality Rotterdam	23/11/2015	Rotterdam (Netherlands)	Policy makers	5	Netherlands
17	Oral presentation to a scientific event	KWR WATER B.V.	Waterboard Delfland	02/12/2015	Delft	Industry	20	Netherlands
18	Oral presentation to a scientific event	KWR WATER B.V.	Meeuwse Goes	21/10/2015	Goes (Netherlands)	Industry	4	Netherlands
19	Oral presentation to a scientific event	KWR WATER B.V.	Network group Industry	09/12/2015	Netherlands	Industry	25	Netherlands
20	Posters	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	50th Anniversary of the international Course of Hydrogeology	01/05/2016	Barcelona (Spain)	Scientific community (higher education, Research)	100	Spain

21	Oral presentation to a scientific event	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	JIA Jornadas de Ingeniería del Agua	22/10/2016	Córdoba (Spain)	Scientific community (higher education, Research) - Industry	30	Spain
22	Oral presentation to a scientific event	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	3rd Innovation day Catalan Water Partership	04/12/2016	Barcelona (Spain)	Scientific community (higher education, Research) - Industry	100	Spain
23	Oral presentation to a scientific event	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	9th International Symposium on Managed Aquifer Recharge	21/06/2016	Mexico City (Mexico)	Scientific community (higher education, Research)	300	International
24	Oral presentation to a wider public	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	iWater Barcelona	15/11/2016	Barcelona (Spain)	Industry	1000	Spain
25	Oral presentation to a wider public	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	II Congrés de l'Aigua a Catalunya	22/03/2017	Barcelona (Spain)	Industry - Civil society	200	Spain
26	Posters	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	43rd IAH International Congress "Groundwater and society: 60 years of IAH"	27/09/2016	Montpellier (France)	Scientific community (higher education, Research)	100	International
27	Oral presentation to a wider public	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	2nd International Ocean Research Conference	17/11/2014	Barcelona (Spain)	Scientific community (higher education, Research)	200	International
28	Oral presentation to a scientific event	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Congress on Groundwater and Global Change in the Western Mediterranean	07/11/2017	Granada (Spain)	Scientific community (higher education, Research)	100	Spain
29	Organisation of Workshops	CETAQUA, CENTRO TECNOLOGI	DESSIN Final Local Workshop in Barc	12/12/2017	Barcelona (Spain)	Scientific community (higher educat	100	Spain

		CO DEL AGUA, FUNDACION PR IVADA	elona			ion, Research) - Ind ustry - Policy makers		
30	Videos	CETAQUA, CEN TRO TECNOLOGI CO DEL AGUA, FUNDACION PR IVADA	Llobregat Demo Case Video	21/12/2017	Barcelona (Spain)	Medias	1000	Spain, Internacional
31	Videos	CETAQUA, CEN TRO TECNOLOGI CO DEL AGUA, FUNDACION PR IVADA	DESSIN Project Video	22/12/2017	Barcelona (Spain)	Medias	10000	International
32	Oral presentation to a scientific event	NATIONAL T ECHNICAL U NIVERSITY OF AT HENS - NTUA	Athens Case: Sewer Mining for Urban Re-use enabled by A dvanced Monitoring Infrastructure	14/06/2016	DemoWare Water Reuse Conference, Barcelona, 13-14 June 2016	Scientific comm unity (higher educat ion, Research) - Ind ustry	50	International
33	Videos	EMSCHERGENOS SENSCHAFT	DESSIN - 1st show case movie Emscher case: General	08/09/2016	Arnhem / Emscher	Scientific comm unity (higher educat ion, Research) - Ind ustry		European countries
34	Videos	EMSCHERGENOS SENSCHAFT	DESSIN - 2nd sh owcase movie Em scher Case: Lamella settler	12/12/2016	Arnhem / Emscher	Scientific comm unity (higher educat ion, Research) - Ind ustry		European countries
35	Videos	EMSCHERGENOS SENSCHAFT	DESSIN - 3rd show case movie Emscher Case: real-time con trol sewage system	23/03/2017	Arnhem / Emscher	Scientific comm unity (higher educat ion, Research) - Ind ustry		European countries
36	Oral presentation to a scientific event	EMSCHERGENOS SENSCHAFT	5th Ecological Collo quium of the BfG & PIANC-Seminar	05/05/2015	Koblenz, Germany	Scientific comm unity (higher educat ion, Research)	115	Germany
37	Oral presentation to a scientific event	EMSCHERGENOS SENSCHAFT	DGL conference - Deutsche Gesellsch aft für Limnologie	26/09/2016	Magdeburg, Germ any	Scientific comm unity (higher educat ion, Research)	40	German speaking countries
38	Oral presentation to a scientific event	EMSCHERGENOS SENSCHAFT	European Ecosys tem Services Co nference	19/09/2016	Antwerp, Belgium	Scientific comm unity (higher educat ion, Research)	3	European countries
39	Oral presentation to a scientific event	EMSCHERGENOS SENSCHAFT	Essener Tagung	15/04/2015	Aachen, Germany	Scientific comm unity (higher educat	1000	Germany

						ion, Research) - Industry - Policy makers		
40	Oral presentation to a scientific event	EMSCHERGENOSSENSCHAFT	IWA Cities of the Future Conference - Transitions to the Urban Water Services of Tomorrow (TRUST)	28/04/2015	Mülheim, Germany	Scientific community (higher education, Research)	150	Germany
41	Oral presentation to a scientific event	EMSCHERGENOSSENSCHAFT	Conference Nature based solutions & Urban Agenda	31/05/2016	Utrecht, Netherlands	Scientific community (higher education, Research) - Policy makers	30	European countries
42	Posters	EMSCHERGENOSSENSCHAFT	DGL conference - Deutsche Gesellschaft für Limnologie	21/09/2015	Essen, Germany	Scientific community (higher education, Research)	100	German speaking countries
43	Oral presentation to a scientific event	EMSCHERGENOSSENSCHAFT	Workshop Urbane Biodiversität (urban biodiversity)	23/03/2017	Essen, Germany	Scientific community (higher education, Research) - Policy makers	100	Germany
44	Posters	EMSCHERGENOSSENSCHAFT	LESAM conference	22/06/2017	Trondheim, Norway	Scientific community (higher education, Research)	150	International
45	Oral presentation to a scientific event	EMSCHERGENOSSENSCHAFT	Forum Wissen (Emschergenossenschaft internal)	01/09/2017	Essen, Germany	Scientific community (higher education, Research)	40	Germany
46	Oral presentation to a scientific event	EMSCHERGENOSSENSCHAFT	DWA Flussgebietsmanagement conference	23/11/2017	Essen, Germany	Scientific community (higher education, Research) - Policy makers	100	Germany
47	Oral presentation to a scientific event	EMSCHERGENOSSENSCHAFT	aqualon conference	06/02/2018	Osnabrück, Germany	Scientific community (higher education, Research) - Civil society - Policy makers	45	Germany
48	Organisation of Workshops	ETAIREIA YDREYSEOS KAI APOCHETEFSEOS PROTEYOYSIS ANONIMI ETAIREIA	Daily workshop for undergraduate students	23/05/2017	R & D Dept of EYDAP (Athens, Greece)	Scientific community (higher education, Research)	50	Greece

49	Organisation of Workshops	ETAIREIA Y DREYSEOS KAI APOCHETEFSEOS PROTEYOYSIS A NONIMI ETA IREIA	Daily workshop for Municipal Water Supply and Sewerage Companies of Greece	25/05/2017	R & D Dept of EYDAP (Athens, Greece)	Industry	60	Greece
50	Flyers	ETAIREIA Y DREYSEOS KAI APOCHETEFSEOS PROTEYOYSIS A NONIMI ETA IREIA	82nd Thessaloniki International Fair	09/09/2017	Thessaloniki International Fair	Civil society	100000	global exhibition
51	Flyers	ETAIREIA Y DREYSEOS KAI APOCHETEFSEOS PROTEYOYSIS A NONIMI ETA IREIA	81st Thessaloniki International Fair	10/09/2016	Thessaloniki International Fair	Civil society	100000	global exhibition
52	Oral presentation to a wider public	ETAIREIA Y DREYSEOS KAI APOCHETEFSEOS PROTEYOYSIS A NONIMI ETA IREIA	Panhellenic Association of Environmental Protection Enterprises (PASEPPE) awards eydap SA for DESSIN in two categories "Products and Services" and "Business and Biodiversity".	19/10/2016	Eugenides Foundation, Athens	Industry - Civil society - Policy makers - Medias	100000	Greece
53	Flyers	ETAIREIA Y DREYSEOS KAI APOCHETEFSEOS PROTEYOYSIS A NONIMI ETA IREIA	MAZINNOV innovation network, Second forum in Athens	10/11/2017	Athens, city centre	Civil society - Medias	2000	Greece, France
54	Oral presentation to a wider public	ETAIREIA Y DREYSEOS KAI APOCHETEFSEOS PROTEYOYSIS A NONIMI ETA IREIA	Event organized by EYDAP for the world water day	22/03/2016	EYDAP HQs, Athens	Civil society	500	Greece
55	Videos	NATIONAL TECHNICAL UNIVERSITY OF ATHENS - NTUA	DESSIN sewer mining easily explained Animation video	14/03/2017	World wide web	Scientific community (higher education, Research) - Industry - Civil society		International

						- Policy makers - Medias		
56	Interviews	KWR WATER B.V.	Koen Zuurbier pro moveert op ondergr ondse wateropslag, Onder Glas.	01/10/2016	-	Scientific comm unity (higher educat ion, Research)		Netherlands
57	Oral presentation to a scientific event	KWR WATER B.V.	Subsurface water sol ution for a climate proof freshwater sup ply	01/05/2016	Amsterdam	Scientific comm unity (higher educat ion, Research)		Netherlands
58	Interviews	KWR WATER B.V.	Ondergrondse wa teropslag goed voor het Westland	01/10/2016	Dichterbij West land Rabobank, pp. 22-25	Scientific comm unity (higher educat ion, Research)		Netherlands
59	Interviews	KWR WATER B.V.	Terugwinning van zoet water verbete ren bij ondergrondse wateropslag	01/03/2016	www.glastuinbou wwaterproof.nl	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers - Medias		Netherlands
60	Organisation of Conference	KWR WATER B.V.	Combining aquifer storage and recovery with reverse osmosis (ASRO Westland) to provide a reliable ec osystem service,	01/10/2016	European Ecosys tem Service Confer ence, Antwerp, Be lgium	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers - Medias		Europe
61	Articles published in the popular press	KWR WATER B.V.	Wereld komt kijken naar "zilte" ondergro ndse wateropslag	01/10/2015	AD Haagsche Cou rant	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers - Medias		Netherlands
62	Articles published in the popular press	KWR WATER B.V.	Schoon regenwater kan nu ook de bod em in	01/10/2016	AD Haagsche Cou rant	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers - Medias		Netherlands
63	Articles published in the popular press	KWR WATER B.V.	Zoet water in droge tijden is goud waard	01/10/2015	PZC Zeeuws Nieu ws	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers -		Netherlands

						Medias		
64	Interviews	KWR WATER B.V.	KWR in het nieuws K.G. Zuurbier - Met ondergrondse sei zoenopslag gietwa ter geen droge zom ers meer,	01/01/2017	KWR in het nieuws K.G. Zuurbier - Met ondergrondse seizoenopslag giet water geen droge zomers meer,	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers - Medias		Netherlands
65	Organisation of Conference	KWR WATER B.V.	Over infiltreren en terugwinnen in Laag-Nederlaned, een handreiking,	01/10/2016	Spaarwater Confer entie, Lelystad.	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers - Medias		Netherlands
66	Organisation of Conference	KWR WATER B.V.	Teruglopende voor raad zoet groundwa ter noopt internatio nal tot maatregelen	01/05/2016	ISMAR9 en Ag-gr oundwater (San Francisco)	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers - Medias		International
67	Organisation of Conference	KWR WATER B.V.	Increasing freshwate r recovery upon aqui fer storage in brack ish-saline aquifers, what can hydrogeolo gical engineering br ing?	01/05/2016	ismar 9, Mexico city	Scientific comm unity (higher educat ion, Research) - Ind ustry - Civil society - Policy makers - Medias		International
68	Oral presentation to a scientific event	UNIVERSITAET DUISBURG-ESS EN	Understanding how changes in freshw ater quality affect delivery of ecosyste m services	19/11/2014	EurAqua-WssTP w orkshop, Olso (Nor way)	Scientific comm unity (higher educat ion, Research)	50	International
69	Oral presentation to a scientific event	UNIVERSITAET DUISBURG-ESS EN	Unravelling the rela tionships between ec ological status and the delivery of ecos ystem services in fr eshwaters	22/09/2016	European Ecosys tem Services co nference, Antwerp (Belgium)	Scientific comm unity (higher educat ion, Research)	70	International
70	Oral presentation to a scientific event	UNIVERSITAET DUISBURG-ESS EN	DESSIN - Demons trate Ecosystem Services Enabling I nnovations in the Water Sector	03/10/2016	RESI project meet ing, Neuburg (Germany)	Scientific comm unity (higher educat ion, Research)	40	International

71	Oral presentation to a scientific event	UNIVERSITAET DUISBURG-ESSEN	Managing multiple stress for multiple benefits: Scientific research to implement the Water Framework Directive (WFD)	08/06/2017	AZTI Summer School, San Sebastian (Spain)	Scientific community (higher education, Research)	70	International
72	Posters	UNIVERSITAET DUISBURG-ESSEN	Potential analysis for RTC of urban drainage systems with simulation of 5 stormwater treatment tanks	21/09/2015	10th International Conference on Urban Drainage Modelling, Québec, (Canada)	Scientific community (higher education, Research)		International
73	Posters	KWR WATER B.V.	Potential improvement of urban drainage systems using model predictive control	21/09/2015	10th International Conference on Urban Drainage Modelling , Québec (Canada)	Scientific community (higher education, Research)		International
74	Oral presentation to a scientific event	AMPHOS 21 CONSULTING SL	CWP innovation days: Ecosystem services as a tool to foster the implementation of managed aquifer recahrge activities	24/11/2015	Barcelona	Industry	100	Spain
75	Posters	AMPHOS 21 CONSULTING SL	DemoWare Water Reuse Conference, Barcelona, 13-14 June 2016	14/06/2016	Barcelona (Spain)	Scientific community (higher education, Research) - Policy makers	80	Spain and UK
76	Web sites/Applications	AMPHOS 21 CONSULTING SL	Downloads of the model to evaluate MAR in saline intrusion coastal areas	02/11/2015	Barcelona	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	300	International
77	Oral presentation to a scientific event	UFT- UMWELT-UND FLUID-TECHNIK DR H BROMBACH GESELLSCHAFT MBH	Einsatz von Schrägklärern zur Regenwasserbehandlung: Sind Aussagen über Wirkungsgrade übertragbar?	27/09/2016	Aqua Urbanica, Rigi-Kaltbad, Switzerland	Scientific community (higher education, Research)	200	German speaking countries
78	Oral presentation to a scientific event	INRIGO WATER AS	Water Innovation Conference, Norway	07/03/2017	Oslo, Norway	Scientific community (higher education, Research) - Ind	100	Norway

						ustry - Policy makers		
79	Oral presentation to a scientific event	STIFTELSEN SINTEF	DESSIN - Presentation at Vannforsk seminar	16/11/2015	Oslo, Norway	Scientific community (higher education, Research) - Industry	50	Norway
80	Oral presentation to a scientific event	STIFTELSEN SINTEF	Stormwater management DESSIN - Improving water quality in a peri-urban area	02/12/2014	Trondheim, Norway	Scientific community (higher education, Research)	30	Norway
81	Oral presentation to a wider public	STIFTELSEN SINTEF	DESSIN - Presentation to 'Hoffselvens venner'	27/01/2016	Oslo, Norway	Civil society	15	Norway
82	Oral presentation to a wider public	STIFTELSEN SINTEF	DESSIN - Information meeting for neighbours of demo plant	30/05/2016	Oslo, Norway	Civil society	5	Norway
83	Oral presentation to a scientific event	STIFTELSEN SINTEF	DESSIN - Presentation for KLIMA 2050	29/06/2016	Trondheim, Norway	Scientific community (higher education, Research) - Industry	30	Norway
84	Oral presentation to a wider public	STIFTELSEN SINTEF	Observation study with 'Hoffselvens Venner'	14/02/2017	Oslo, Norway	Civil society	10	Norway
85	Oral presentation to a scientific event	STIFTELSEN SINTEF	Innovative solutions for improved water quality and local CSO treatment - experiences from the DESSIN project	24/02/2017	Oslo, Norway	Scientific community (higher education, Research) - Industry - Policy makers	50	Norway
86	Oral presentation to a scientific event	STIFTELSEN SINTEF	Local treatment of CSO - Results from the DESSIN project. Lecture at the Annual training seminar of TEKNA - The Norwegian Society of Graduate Technical and Scientific Professionals	12/01/2017	Trondheim, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	100	Norway

87	Oral presentation to a scientific event	STIFTELSEN SINTEF	Tools and methods for evaluation of social and economic sustainability. Lecture at the Annual training seminar of TEKNA - The Norwegian Society of Graduate Technical and Scientific Professionals.	10/01/2018	Trondheim, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	50	Norway
88	Videos	STIFTELSEN SINTEF	DESSIN - Hoffselva showcase video	07/12/2017	Oslo, Norway	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		International
89	Posters	DHI	A software tool for ecosystem service assessments	30/01/2017	Danish Water Forum	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	100	Denmark
90	Posters	DHI	A software tool for ecosystem service assessments	25/04/2017	EGU General Assembly, Vienna	Scientific community (higher education, Research)	250	International
91	Articles published in the popular press	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATUNGS-UND ENTWICKLUNGS GESELLSCHAFT MBH	Europäisches Forschungsprojekt DESSIN entwickelt Leitfaden für die Bewertung von Ökosystemleistungen	01/03/2017	Journal gwf Wasser - Abwasser (EU Special)	Scientific community (higher education, Research) - Civil society	2200	Germany
92	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	DESSIN Annual Magazine 1	08/04/2015	International	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		International
93	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	DESSIN Annual Magazine 2	22/04/2016	International	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		International

94	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	DESSIN Annual Magazine 3	06/04/2017	International	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias		International
95	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	DESSIN - ESS Evaluation Framework (Brochure)	21/09/2016	International	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		International
96	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	DESSIN Leaflet	10/06/2015	International	Scientific community (higher education, Research) - Industry - Civil society - Policy makers		International
97	Oral presentation to a scientific event	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATUNGS-UND ENTWICKLUNGS GESELLSCHAFT MBH	Bewertung von Ökosystemdienstleistungen in EU-DESSIN und BMBF-Flusshygiene	24/01/2017	Crosscutting working group "Ecosystem Services" of BMBF-ReWaM, Dresden (Germany)	Scientific community (higher education, Research)	23	Germany
98	Oral presentation to a scientific event	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATUNGS-UND ENTWICKLUNGS GESELLSCHAFT MBH	Demonstrate that ecosystem services are enabling innovation in the water sector	02/11/2017	JPI Exploratory Workshop, Dublin, Ireland	Scientific community (higher education, Research) - Policy makers	50	20 european member countries of JPI + 4 observer countries (BE, GR, HU, LT)
99	Organisation of Conference	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATUNGS-UND ENTWICKLUNGS GESELLSCHAFT MBH	Water innovation through ecosystem services, nature-based solutions and hybrid grey-green infrastructure	28/11/2017	Brussels, Belgium (joint workshop with WssTP)	Scientific community (higher education, Research) - Industry - Policy makers	55	European countries
100	Oral presentation to a scientific event	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATU	"Efforts awarded" at the session "Boosting Research & Innovation in the	29/09/2017	EC-organised side event at Water Innovation Porto (EIP Annual Conferen	Scientific community (higher education, Research) - Industry - Policy	100	European countries

		NGS-UND EN TWICKLUNGS GESELLSCHAFT MBH	Water Sector"		ce)	makers		
101	Articles published in the popular press	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATU NGS-UND EN TWICKLUNGS GESELLSCHAFT MBH	Ökosystemleistu ngen messen und be werten - Anwendun g des "DESSIN ESS Evaluation Framew orks" am Beispiel de s Emscherumbaus	01/12/2016	IWW Journal	Scientific comm unity (higher educat ion, Research) - Ind ustry - Policy makers	2000	German speaking countries
102	Articles published in the popular press	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATU NGS-UND EN TWICKLUNGS GESELLSCHAFT MBH	Nicht überflüssig - Forschungs- und Innovationsförderun g	03/03/2014	meo - Das Wirts chaftsmagazin	Industry - Policy makers - Medias	40000	Germany
103	Articles published in the popular press	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATU NGS-UND EN TWICKLUNGS GESELLSCHAFT MBH	Auch an der Ems cher fördert die EU	23/05/2014	VDI Nachrichten (weekly newspaper for engineers and technical staff)	Industry - Civil soc iety - Policy makers	228000	German speaking countries
104	Articles published in the popular press	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATU NGS-UND EN TWICKLUNGS GESELLSCHAFT MBH	Unterirdischer Wasserspeicher fürs Gewächshaus	31/10/2014	VDI Nachrichten (weekly newspaper for engineers and technical staff)	Industry - Civil soc iety - Policy makers	228000	German speaking countries
105	Oral presentation to a scientific event	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATU NGS-UND EN TWICKLUNGS GESELLSCHAFT MBH	The DESSIN ESS Evaluation Fram ework	21/06/2016	Brussels, WssTP Working Group Ecosystem Services	Scientific comm unity (higher educat ion, Research) - Pol icy makers	20	European countries

106	Posters	IWW RHEINISCH-WESTFALISCHES INSTITUT FUER WASSER BERATUNGS-UND ENTWICKLUNGS GESELLSCHAFT MBH	The Ecosystem Services Approach for water challenges: The DESSIN ESS Evaluation Framework	26/09/2017	EC booth at the EIP Water Innovation Week, Porto, Portugal	Scientific community (higher education, Research) - Industry - Policy makers		European countries
107	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Newsletter 1	08/07/2014	distributed through mailing lists (subscription-based)	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	300	International
108	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Newsletter 2	04/12/2014	distributed through mailing lists (subscription-based)	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	300	International
109	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Newsletter 3	15/06/2015	distributed through mailing lists (subscription-based)	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	300	International
110	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Newsletter 4	30/10/2015	distributed through mailing lists (subscription-based)	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	300	International
111	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Newsletter 5	25/07/2017	distributed through mailing lists (subscription-based)	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	300	International
112	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	Newsletter 6	15/11/2017	distributed through mailing lists (subscription-based)	Scientific community (higher education, Research) - Civil society - Policy makers	300	International
113	Flyers	CETAQUA, CENTRO TECNOLOGICO DEL AGUA, FUNDACION PRIVADA	DESSIN Final Magazine	20/12/2017	International	Scientific community (higher education, Research) - Industry - Civil society - Policy makers -	2500	International

						Medias		
114	Organisation of Workshops	ECOLOGIC INSTITUT gemeinnützige GmbH	S1 Using the DESSIN ecosystem services evaluation framework to assess changes in ecosystem services resulting from the implementation of innovative water technologies Workshop at S-cluster (Sessions related to projects/processes) at the European Ecosystem Services 2016 conference	22/09/2016	Antwerp, Belgium	Scientific community (higher education, Research) - Civil society - Policy makers	200	EU Member States
115	Web sites/Applications	ECOLOGIC INSTITUT gemeinnützige GmbH	Webinar on the DESSIN ESS Evaluation Framework	06/09/2016	Berlin, Germany	Scientific community (higher education, Research) - Policy makers	40	EU Member States
116	Oral presentation to a scientific event	ADELPHI RESEARCH GEMEINNUTZIGE GMBH	Porto Water Innovation Week	27/09/2017	Porto (Portugal)	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	20	Portugal, international
117	Oral presentation to a scientific event	ADELPHI RESEARCH GEMEINNUTZIGE GMBH	World Water Week	29/08/2016	Stockholm (Sweden)	Scientific community (higher education, Research) - Industry - Civil society - Policy makers	50	Sweden, International
118	Flyers	ADELPHI RESEARCH GEMEINNUTZIGE GMBH	Technology Flyers focussing on ESS benefits	04/10/2016	Berlin	Scientific community (higher education, Research) - Industry - Civil society - Policy makers - Medias	1000	international

Section B (Confidential or public: confidential information marked clearly)

LIST OF APPLICATIONS FOR PATENTS, TRADEMARKS, REGISTERED DESIGNS,UTILITY MODELS, ETC.					
Type of IP Rights	Confidential	Foreseen embargo date dd/ mm/yyyy	Application reference(s) (e.g. EP123456)	Subject or title of application	Applicant(s) (as on the application)
Patents	No		DE102013210473	Vorrichtung zum Klären von Abwasser	Weiß, Gebhard

OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND								
Type of Exploitable Foreground	Description of Exploitable Foreground	Confidential	Foreseen embargo date dd/mm/yyyy	Exploitable product(s) or measure(s)	Sector(s) of application	Timetable for commercial use or any other use	Patents or other IPR exploitation (licences)	Owner and Other Beneficiary(s) involved
Commercial exploitation of R&D results	Evaluation Framework for Ecosystem Services and Sustainability (D 11.2) and experience with its application (D13.1, D31.2, D32.3, D 33.2, D34.3, D35.2)	No		Consulting services to apply the ESS concept for better decision-making	European and international Water Sector (e.g. water supply and sanitation, water boards, river basin	immediately	no	IWW, Ecologic, EG, CETaqua, DHI, KWR, SINTEF, UDE
General advancement of knowledge	Evaluation Framework for Ecosystem Services and Sustainability (D 11.2) and experience with its application (D13.1, D31.2, D32.3, D 33.2, D34.3, D35.2)	No		Follow-up R&D&I activities to improve the ESS valuation framework	Water sector	immediately	no	IWW, Ecologic, EG, CETaqua, DHI, KWR, SINTEF, UDE
Exploitation of results through EU policies	Evaluation Framework for Ecosystem Services and Sustainability (D 11.2) and experience with its application (D13.1, D31.2, D32.3, D 33.2, D34.3, D35.2)	No		Consulting services for policy makers	Public sector	immediately	no	Ecologic, IWW, EG, CETaqua, DHI, KWR, SINTEF, UDE
Exploitation of results through (social) innovation	Governance regime factors and financing approaches conducive to innovation in the water sector (WP12 outcomes D12.1 to D12.3)	No		Knowledge and policy recommendations on governance regime factors and financing approaches conducive to innovation in the water sector	Public sector, water sector	immediately	no	Ecologic, IWW, CETaqua, SINTEF, DHI, EG
Exploitation of results through (social) innovation	Evaluation Framework for Ecosystem Services and Sustainability (D	No		ESS Evaluation concept as a tool to improve stakeholder dialogue and	Water sector	immediately, permanent	no	EG, external partners

	11.2) and experience with its application (D13.1, D31.2)			support participatory decision-making processes in a region.				
General advancement of knowledge	Evaluation Framework for Ecosystem Services and Sustainability (D 11.2) and experience with its application (D13.1, D31.2,)	No		Knowledge transfer to pupils, students, own employees, externals, and follow-up R&D&I activities; use in higher education and teaching	water sector, academia, international school network	already started, indefinite	no	EG, UDE, in collaboration with UNESCO school network
Commercial exploitation of R&D results	DESSIN software tool for ESS and sustainability valuation (deliverables from WP23):	No		Software tool for ecosystem service and sustainability assessments, as additional module to an existing and established commercial software suite.	urban water sector	already available, to be supported in definitely	no	DHI
Commercial exploitation of R&D results	Use of cross-flow lamella separators for enhancement of storm water treatment in combined and separate urban drainage systems. Result of WP21, 31 and 32.	No		Plants for combined sewage / stormwater treatment, using a cross-flow lamella separator	Operators, owners of facilities needing combined sewage/ stormwater treatment, e.g. municipalities	already started, indefinite	DE102013210473	UFT
Commercial exploitation of R&D results	IT security know-how in terms of telecontrol, gained through work in WP21 and WP31	No		Improved and secure control and telecontrol systems	all industrial control systems (ICS)	indefinite	no	SEGNO
Commercial exploitation of R&D results	Programming know-how developed through work in WP21 and WP31.	No		Microsoft "Silver Partner" status achieved	Software development	already achieved, to be renewed annually	no	SEGNO
Commercial exploitation of R&D results	Improvement and gain of knowledge in the OPC UA environment (new standard of industrial communication)	No		OPC UA development	Industrial control systems	indefinite	no	SEGNO

	through WP21 and WP31							
Commercial exploitation of R&D results	Knowledge gain in the field of web services for the water sector and other industry, through RTD and demo in WP21 and WP31	No		Provision of new webservices	Software development for the water sector and other industry customers	immediately	none	SEGNO
Commercial exploitation of R&D results	A real-time control system for sewer networks (ADESBA), developed and demonstrated in WP21 and WP31	No		ADESBA Real time control solution for sewer systems	Operators of sewer systems, first in Germany, to be extended in a 2nd step.	start immediately	no	SEGNO, cooperating with EG
General advancement of knowledge	Potential of RTC system and cross-flow lamella settler (WP21 and WP31) for future large-scale application at catchment level	No		Ongoing pilot testing, potential for future large-scale application	Water sector	no timetable	no	EG, SEGNO, UFT, UDE
General advancement of knowledge	Improved understanding of design parameters and their implication on the total efficiency for HRF treatment of sewer overflow, as result of WP21 and WP32.	No		Increased HRF treatment efficiency by improvement of system design base for next generation of HRF treatment systems.	Operators of sewer treatment facilities, municipalities	immediately	no	INRIGO
General advancement of knowledge	Approved performance of high rate filtration as principle for local sewer overflow treatment, as result of WP21 and WP32.	No		HRF systems operation standards	Sewer treatment systems, municipalities	before 2020	no	INRIGO
Commercial exploitation of R&D results	Knowledge generated through RTD and demonstration of high-rate-filtration (HRF) facility for treatment of	No		Improved HRF sewer overflow treatment systems, adapted to manhole installations	Sewer treatment systems, municipalities	within 2020	no	INRIGO

	sewer overflow in WP21 and WP32.							
Commercial exploitation of R&D results	Foreground on turbidity measurement technology gained through RTD and demonstration in WP21 and WP32	Yes	01/01/2020	Turbidity measurement in both drinking water and sewage by improved instruments with automatic cleaning and high tolerance against dry periods.	Operators of Sewer treatment systems, municipalities, drinking water suppliers	2018-2020	no	LKI
General advancement of knowledge	Improved knowledge on CSO treatment by coarse media filtration and lamella settling through RTD and demonstration in WP21 and WP32	No		Consultation services	Water sector	immediately	no	SINTEF
Commercial exploitation of R&D results	Improved knowledge on modelling of rivers with steep level gradients through RTD and demonstration in WP21 and WP32	No		Consultation services	Water sector	immediately	no	SINTEF
Exploitation of results through (social) innovation	Increased experience with public participation in scientific research/citizen science through demonstration in WP32.	No		Consultation services involving participatory approaches with larger societal groups	Water sector	immediately	no	SINTEF
Commercial exploitation of R&D results	Ability to communicate to municipalities, waterboards and other decision makers the benefits of reverse osmosis applications in terms of ecosystem services, through demonstration case in WP33 and applying the ESS frame	No		Reverse osmosis applications	waterboards, municipalities, carwashes, horticulture (greenhouse industry), datacenters	indefinite	no	BWB, KWR

	work from D11.2							
Commercial exploitation of R&D results	Improved and more efficient well-design and ASR-RO solution, key result of WP22.	No		Efficiency increase in ASR schemes by innovative well design and RO application	watersector, horticulture, industry	immediately	no	KWR in collaboration with Allied Waters, and SMEs like BdB and others
Commercial exploitation of R&D results	Market-ready advanced ASRRO systems, proven through demonstration activities in WP33 (D33.1 and D33.2)	No		Full scale application of advanced ASRRO system	watersector, horticulture, industry	immediately	no	KWR in collaboration with Allied Waters, and SMEs like BdB and others
Commercial exploitation of R&D results	Solutions for clogging as a previous limitation for broader application of ASR-RO (outcome of D 22.3).	No		Mitigation of membrane clogging in ASRRO systems by regular flushing of RO-membranes and cleaning of injection wells	industry, horticulture, water sector	immediately	no	Engineering companies,installation SMEs
Commercial exploitation of R&D results	ASRRO ability to mitigate saltwater plume formation and be operated with a neutral to positive impact on the coastal groundwater system (outcome of WP22 and WP33).	No		Decrease in regional chloride concentrations by wide spread application of ASRRO instead of conventional BWRO technology.	industry, horticulture, water sector	3-5 years	no	KWR through collaboration with Allied Waters, SMEs
Commercial exploitation of R&D results	A solution for real-time data monitoring and management for decentralised water treatment units (outcome of WP22 and WP34)	No		Data monitoring and management platform	water sector, energy sector	indefinite	no	TELINT
General advancement of knowledge	Proven and demonstrated concept and technology for sewer mining and decentralized water reuse (outcome WP 22 and WP34)	No		Consulting activities and services on sewer mining technology and decentralized water reuse technologies.	Water Utilities, Industrial & Touristic sector, Local authorities	immediately	no	NTUA

General advancement of knowledge	Proven and demonstrated concept and technology for sewer mining and decentralized water reuse (outcome WP22 and WP34)	No		University level educational and training activities and material, specialist lectures, knowledge-transfer activities, field trips, Athens' Sewer Mining Pilot unit	Higher education	immediately	no	NTUA,EYDAP
General advancement of knowledge	Proven and demonstrated concept and technology for sewer mining and decentralized water reuse (outcome WP22 and WP34)	No		Further research and technology up-scaling, development of domain expert knowledge.	Academia and Research, Water Utilities, Local authorities (municipalities)	immediately	no	NTUA, EYDAP, CHEMITEC, Athens' Municipality
General advancement of knowledge	Tool for implementers to locate Managed Aquifer Recharge (MAR) systems in coastal areas with saline intrusion problems. This tool is based on a numerical model that allows show the main positive impacts of the technique helping to overcome implementation barriers (outcome WP22, in particular D22.5)	No		Numerical model as a tool to evaluate MAR impacts	water managers	5 years	no	A21
Exploitation of results through (social) innovation	Public perception and evaluation of willingness to pay of Llobregat delta area inhabitants for environmental improvements (outcome WP35)	No		Aquifer recharge to restore coastal wetlands	Environmental management	indefinite	no	CETaqua, Aigües de Barcelona
Exploitation of results through (social) innovation	Working group with local stakeholders of Llobregat Delta aquifer to foster	No		Aquifer management	Drinking water management	Expected operational by 2020/2021	no	Cetaqua, Aigues de Barcelona, Llobgregat Delta Aquifer Users Community, Catalan

	implementation of DESSIN results at real-scale (outcome WP35 activities)							Water Authority and Catalan Health Depar tment.
Commercial expl oitation of R&D results	Proven and demo nstrated concept and technology to inject pre-potable w ater for aquifer dir ect recharge (key re sult WP35).	No		Full-scale aquifer i njection of pre-pota ble water, with volu mes around 5-15 Hm3/year at dr inking water plant Sant Joan Despí	Drinking water management	Expected to be op erational in 2020/ 2021	no	Aigues de Barcelona, Catalan Water Agency
General advance ment of knowledge	Monitoring and Evaluation Criteria and Indicators impo rtant for applicabil ity of innovative wa ter technologies (D42.5)	No		Support future R&D&I activities for innovative wat er technologies	water sector	immediately	no	adelphi, general public
Commercial expl oitation of R&D results	Consultancy Ser vice and providing capacity building to SMEs on commerc ialising and maturin g innovative water t echnologies (D4 2.2)	No		Consultancy ser vices for SMEs	Water Sector	immediately	no	adelphi and consorti um members

ADDITIONAL TEMPLATE B2: OVERVIEW TABLE WITH EXPLOITABLE FOREGROUND	
Description of Exploitable Fore ground	Explain of the Exploitable Foreground
Evaluation Framework for Ecosy stem Services and Sustainability (D 11.2) and experience with its appli cation (D13.1, D31.2, D32.3, D 33.2, D34.3, D35.2)	The DESSIN Evaluation Framework for Ecosystem Services (ESS) and Sustainability will be exploited by its owners for future consulting projects imme diately after the ending of the DESSIN project. Scope of such consulting projects will be to enable better decision making (e.g. about technologies or meas ures to select for implementation in the water sector) through quantification of changes in ecosystem services delivery and the evaluation of existing and innovative management measures and policy instruments to improve the status of freshwater ecosystems. Clients of those consulting services could be wa ter utilities, water boards, industrial companies (technology providers), and other stakeholders and decision-makers within the European water sector. We expect a moderate starting phase of 1-2 consulting projects per key partner during the first year, but a significant increase after the ESS valuation concept a nd tool and its potential have gained more publicity and reference applications.
Evaluation Framework for Ecosy stem Services and Sustainability (D 11.2) and experience with its appli cation (D13.1, D31.2, D32.3, D	The knowledge on ESS and sustainability assessment, and the concepts developed for these tasks within the DESSIN project will be further applied and r efined within follow-up R&D&I projects. The focus of these future research could be, for example, on a stronger integration of ESS and sustainability asses sments as well as the sustainability of ESS themselves. Funding for those projects could be provided by regional or national funding agencies, as well as E uropean or international bodies. Project acquisition will start right after the end of the DESSIN project. A network of possible consortium partners has al

33.2, D34.3, D35.2)	ready been built during the project via participation in conferences, and other networking events on ESS. DESSIN outcomes will be linked to already ongo ing European initiatives and research programs (WG MAES, FP7 MARS, etc.) to ensure that database of state parameters, ESS, state indicators and ESS in dicators are up to date and inform the development of other related processes.
Evaluation Framework for Ecosy stem Services and Sustainability (D 11.2) and experience with its appli cation (D13.1, D31.2, D32.3, D 33.2, D34.3, D35.2)	The knowledge gain on the quantification of changes in Ecosystem services will be used in ongoing policy consultancy work on topics such as bioeconomy, application of the ESS concept in the EC Water Framework Directive (WFT), Marine Strategy Framework Directive (MSFD) and biodiversity conservation calls, nature-based solutions and green infrastructure. The DESSIN ESS framework can be used as an example of a tested integrative assessment. This is a relevant topic for the ongoing revision of the EC Water Framework Directive. Specifically the WA1 DESSIN work can be used to inform the design of new status indicators (Drivers-Pressures-State) suitable for evaluation of Water Framework Directive (WFD) Programme of Measures (PoMs). There is also p otential to apply the DESSIN ESS framework and case studies contained in D13.1 to inform the work of WG MAES in target 2 action 5 on the implementa tion of the EC 2020 Biodiversity Strategy. Specifically, to inform the ongoing need for ex-post assessments of management options for ecosystem restorati on and biodiversity protection and conservation.
Governance regime factors and fin ancing approaches conducive to i nnovation in the water sector (WP12 outcomes D12.1 to D12.3)	WP12 outcomes will be promoted for recommendations in financing and governance arrangements for promoting innovations in the water sector. The be neficiaries involved in developing this foreground area all active in their regional and/or national water sector and will use various measures and channels to utilise the results of this WP, e.g. through their own R&D and/or consulting services, participation in expert and stakeholder groups, participation in con sultation processes.
Evaluation Framework for Ecosy stem Services and Sustainability (D 11.2) and experience with its appli cation (D13.1, D31.2)	EG has used the DESSIN ESS framework and the topic of ESS assessment in a Stakeholder Workshop to discuss the mature case “Emscher reconversion”. The DESSIN ESS framework and its sustainability assessment approach represent tools that can be applied to evaluate options of measures and decide for the best alternative in terms of ESS and sustainability. A simplified sustainability assessment approach is already in use for important decisions at EG. Furt hermore, the benefit assessed in the ESS evaluation of the Emscher reconversion are already widely used and presented at EG internal and external meet ings. EG will make further use of the knowledge and experience gained in DESSIN for its involvement in the national ongoing discussions on the revision of the WFD. To this purpose, EG has been and continues to be disseminating the DESSIN outcome through various external channels (scientific publicat ions, oral presentations, posters, blog articles, etc.). This is an already ongoing and continuous effort with no specific timetable or end foreseen so far.
Evaluation Framework for Ecosy stem Services and Sustainability (D 11.2) and experience with its appli cation (D13.1, D31.2,)	The DESSIN ESS framework is an important step to bring the so far more academic concept of ecosystem services into real application. It therefore has a strong exploitation potential also in academic and professional teaching and training. As a starting point, EG has already participated in three UNESCO pu pils conferences, presenting the topic of ecosystem services and conducting a practical ESS evaluation in the field together with the pupils. EG has supe rvised one Bsc student and one Msc student on two topics closely related to DESSIN: a) on the evaluation of the effects of the implementation of the A DESBA-RTC on in-stream nutrient concentrations and qualitative description of ESS affected and b) on the ESS affected through the restoration of the E mscher mouth with focus on cultural ESS.EG has also already involved one PhD student in the quantification of ESS in DESSIN’s Emscher mature case, an d is now involved in two BMBF-funded research projects (STEER and URBANTIP). In both projects, EG makes use of the knowledge and experience on the topic of ESS gained in DESSIN and brings in the ESS approach as a key element of these new research projects. EG collaborates closely with the UN ESCO school network and UDE who will use DESSIN results in their teaching and educational activities.
DESSIN software tool for ESS and sustainability valuation (deliverable s from WP23):	The DESSIN software tool was developed to assist practitioners implementing the DESSIN ESS evaluation framework and sustainability assessment. The software tool guides users through the workflows of both methodologies, and provides access to indicator databases that are used to quantify impacts at dif ferent stages. The tool also provides functionality to display and compare results, enabling comparison of different measures. The tool can be used to extend cost-benefit analysis to include ESS impacts and thereby supports consideration of ecosystems as active contributors to human welfare. The tool has been developed as an additional / optional module for the MIKE software suite commercially provided by DHI (www.mikepoweredbydhi.com). The basic ve rsion of the software tool is available for free. However, there is a license cost for some extended components that make use of propriety background. Both the free and extended version are currently available through DHI and will be supported indefinitely. The cost of MIKE Workbench with the extended mo dule will be EUR 3600. The initial purchase cost includes one year of support and updated. Support and updates for additional years cost EUR 900 / year. Assuming 10 organisations purchase MIKE Workbench for the ESS tool and extended components over the next 5 years, and that each purchase has two ye ars’ additional support and updates, this works out to about 54,000 EUR.
Use of cross-flow lamella separator s for enhancement of storm water tr eatment in combined and separate	Within DESSIN, an innovative cross-flow lamella settler was developed and designed in detail by UFT. Special features are horizontal flow direction, w hich eases application and allows also retrofit in conventionally designed settling basins, and automatic cleaning by pivoting of the devices under water. UFT could thus could make the cross-flow settler a readily available commercial product (see product brochure http://www.uft.eu/fileadmin/user_upload/

urban drainage systems. Result of WP21, 31 and 32.	produkte/hydro-mechanik/ausruestung/023_grobstoffrueckhalt/0237x_XSK/P511_01_237.pdf) and has already built a full-scale commercial plant (in Eutingen, southern Germany) which is in operation since September 2017. The new product can be used for treatment of stormwater or combined sewage in urban drainage systems. Clients are operators of such drainage systems who are forced by EC guidelines such as the Water Framework Directive to operate the sewer systems properly and use best possible technologies in order to acquire a good ecological status of receiving waters. An essential issue is the possibility to retrofit the new solution into existing settling tanks. UFT expects a growing market in the future, since in current technical guidelines, standard settling basins are reported to be not very efficient concerning the very fine sewage-borne sediments. Lamella settlers, on the other hand, show significantly better settling efficiencies. There is already some technical guidance in German DWA guidelines to design lamella settlers so that the general acceptance is given.Within the next five years UFT expects approximately 20 successful installations of this innovative lamella settler type with a financial turnover of roughly € 50.000 to 100.000 per unit, so the total generated turnover may reach 1-2 million €. UFT expects increasing numbers of installations in the following years.
IT security know-how in terms of telecontrol, gained through work in WP21 and WP31	New laws demand compliance with IT security measures in control technology. In the field of industrial control systems (ICS), currently only a limited amount of literature and knowledge about IT security is available. In the context of DESSIN, SEGNO has gained significant IT security know-how. This know-how will have benefits for the whole company and its industry clients. Specific foreground has been achieved in telecontrol engineering, which is an area with few information sources on the subject of IT security. This will give SEGNO a competitive advantage to be more successful in acquisition of contracts.
Programming know-how developed through work in WP21 and WP31.	The Microsoft Partner Network is a network for very highly qualified specialists. This network provides a set of benefits to help our business grow. Microsoft silver has strict certification rules and represents a quality certificate for the respective partner. In addition to some general tests, relevant references in the field of programming with Microsoft products are required. The work and experience achieved by SEGNO within DESSIN was instrumental to obtain a certification as "Microsoft Silver Partner". This is a competitive advantage and will help to develop modern designed software for application in a broad range of sectors.
Improvement and gain of knowledge in the OPC UA environment (new standard of industrial communication) through WP21 and WP31	WinCC control system) via the industry standard OPC UA.Through DESSIN, SEGNO has develop an own OPC UA server and an OPC UA client as a plug-in with the aid of the .Net-based OPC UA Client & Server SDK (bundle). Thus, ADESBA can manage data as an OPC server and make it available to other clients (devices from various manufacturers) as well as pick up and / or send data from another central OPC server as an OPC client. This development can also be used for other systems and ideas. Data integration via OPC UA is significant easier than with proprietary bus systems, because meta information is available in addition to the pure data. The Configuration and commissioning of the data connection is possible across network boundaries and still secure. OPC UA makes minimal demands on the network infrastructure, is robust, and has integrated security such as encryption and authorization.
Knowledge gain in the field of web services for the water sector and other industry, through RTD and demo in WP21 and WP31	The ADESBA Control Module (ADESBA-RTC) provides real-time data as a web server using web services for viewing in web browsers. The knowledge for the development of a web service and a web server has been collected and put to practical use. This required some .Net libraries like "Owin" and "SignalR". For the representation of the data also knowledge about JavaScript and its application had to be collected. The web server was developed as a plug-in, which manages data and makes it available to the web services for presentation. The web server enables data representation not only within a network, but also across networks via a shared port. The own web server is independent and can thus be viewed decoupled from web applications. This technology can be developed further and will be applied by SEGNO also to other sectors.
A real-time control system for sewer networks (ADESBA), developed and demonstrated in WP21 and WP31	SEGNO is aiming to develop the successfully tested ADESBA solution at the Emscher site into a reference case with continuous operation. To this purpose, a special permit from the relevant authorities is needed to continue the use of ADESBA in the sewer Network of EG. The ambition is to achieve a regional roll out in a larger part of the Emscher area, and use this reference case in future dissemination, sales and marketing campaigns for the ADESBA solutions. The first target area for market entry for ADESBA will be German-speaking countries, because here SEGNO is familiar with the regulatory framework and official routes for approval. But SEGNO has already knowledge of other network operators beyond Germany with an interest in ADESBA. Aiming at the European market will be a 2nd step after 2020. Based on the sewer network structure, number of storage systems and existing technical infrastructure, SEGNO calculates for each customer (wastewater association, large sewage treatment plant) between € 75,000 and € 200,000 for each implementation. With the current SEGNO own sales structure with about 2 to 3 new customer acquisitions per year, this means a total volume of around € 750k to € 3 million in the next 5 years. The worldwide sale rights are 100% in the company SEGNO, so the market is currently almost unlimited for SEGNO.
Potential of RTC system and cross-flow lamella settler (WP21 and WP31) for future large-scale applic	After the demonstrated beneficial application of the ADESBA-RTC, EG as a site owner and operator of the sewer system, with the support of its partner institution SEGNO, plans to further engage in the RTC technology implemented in DESSIN. It is planned to continue the operation of the Emscher RTC pilot for at least one more year, conducting further research (involving DESSIN partner UDE) regarding its efficiency and upscaling potential to sub-basin level.

ation at catchment level	After the first demonstrated application of the cross-flow lamella settler, EG as a site owner and operator of the CSO facilities plans to identify a possible second pilot site for testing the cross-flow lamella settler using different combined sewage with different types of particles, as the efficiency results obtained in DESSIN need to be validated at an additional site with distinct sewage conditions. This is to be conducted with support of UFT and UDE and with the aim of future full-scale application in suitable existing or planned CSO facilities in which particle concentration needs to be minimized. There is a potential for future large-scale application of the demonstrated innovative technologies by the water boards Emschergenossenschaft and Lippeverband (together responsible for an area of 4100 km2 and 3.6 Mio inhabitants), especially to adapt existing water infrastructures to climatic and demographic changes in the future.
Improved understanding of design parameters and their implication on the total efficiency for HRF treatment of sewer overflow, as result of WP21 and WP32.	The DESSIN project has provided improved understanding of different design parameters and their implication on the total efficiency for treatment of sewer overflow in local river systems. This knowledge will be exploited by Inrigo in the development and operation of next generation HRF treatment systems. The impact can be increased HRF treatment efficiency by improvement of system design base. Acquired knowledge may also be subject to future development and establishment of an extended service portfolio. These services can help increase the value for the customer / user of the technology.
Approved performance of high rate filtration as principle for local sewer overflow treatment, as result of WP21 and WP32.	The DESSIN project has provided documentation of functionality and initial design of the HRF technology necessary to reduce local pollution of urban water systems. It provides vital input necessary for further development of the technology. This will be immediately exploited by Inrigo and partners (suppliers) to improve the robustness of year-around operational procedures of HRF systems. By visualizing these features and documenting them in operating standards, this will provide an increased knowledge base for municipalities and others who need to invest in combined sewer overflow treatment systems. The purpose is to create an improved market position for the HRF technology (cf. next entry).
Knowledge generated through RTD and demonstration of high-rate-filtration (HRF) facility for treatment of sewer overflow in WP21 and WP32.	Knowledge and results obtained in DESSIN will be applied by Inrigo in the development of next generation HRF system for treatment of sewer overflow. This system will be adapted to manhole installations to meet requirements for urban low footprint installation and cold climate operation. It is a goal to introduce the product to the market before 2020, primarily in Europe. From 2020, possible sales are estimated to be in the range of 10-20 units per year. It is estimated that this turnover will be doubled over a 5-year period, providing a potential annual turnover of EUR 10 million at the end of the period.
Foreground on turbidity measurement technology gained through RTD and demonstration in WP21 and WP32	Based on the results made during the test period, LKI was able to address customers in the water sector (both in drinking water and in sewer treatment sector) and present the different instruments and the use of automatic cleaning. The results on offset after this long period of testing and leaving the sensors dry for longer period, enabled LKI to make test installations which at the end resulted in actual sales. So far LKI has received two orders for a total of EUR 12 700,- and if these customers are as satisfied after 6 months as they are now, sales rates are expected to increase to at least 5-6 such orders per year, since a lot of upgrading is going on. The introduction of turbidity measurement has also enabled LKI to introduce color measurement (for potable water), resulting in an even increased turnover. LKI is not aiming to export their instruments internationally, but foreground generated in DESSIN will open new doors in Norway.
Improved knowledge on CSO treatment by coarse media filtration and lamella settling through RTD and demonstration in WP21 and WP32	SINTEF can exploit the general knowledge on coarse media filtration and lamella settling gained in DESSIN in future projects.
Improved knowledge on modelling of rivers with steep level gradients through RTD and demonstration in WP21 and WP32	SINTEF can exploit the knowledge gained in DESSIN on how to model rivers with steep level gradients in future R&D and R&D-based consulting projects.
Increased experience with public participation in scientific research/ citizen science through demonstration in WP32.	User participation in water management and research is increasingly emphasized, and SINTEF can exploit the knowledge and experience gained from the collaboration with the local citizen group “Hoffselvens Venner” in future consulting projects, both in Norway and/or the EU.
Ability to communicate to municip	In the Netherlands all groundwater extractions and infiltrations are subject to some sort of permission from a policy maker. Whether these are local politi

alities, waterboards and other decisi on makers the benefits of reverse o smosis applications in terms of eco system services, through demon stration case in WP33 and applying the ESS framework from D11.2	cians, municipality officials or waterboard members, each of them has reasons to limit extraction of brackish water and infiltration of brine to deeper layers. The DESSIN result in WP33 (Westland) was that the quality of the existing layer was improved by storing excessive rainwater in an aquifer, thus solving 2 problems: i) prevent the salinization of groundwater, ii) solving the problem of excessive rainwater (and flooding). For BDB, the ability to show these bene fits and co-benefits of the solution (through the ESS approach developed in DESSIN) helped to obtaining a permit to withdraw groundwater and inject br ine for a carwash in the municipality of Zaandam, where in a first attempt a permit had been rejected. With this permission as a reference case, BdB is able to proof to other decision makers that their solutions are beneficial to the environment and they are able to quantify the benefits to decision makers and cl ients. Main exploitable foreground of Dessin for BDB is that with the framework the services supported by their solutions can be quantified in terms of eco nomic benefits for the clients and even the broader community. The benefits of the Westland project are extensively promoted by KWR. BdB will use these promotions as reference cases and selling proposition how their products can contribute to solve environmental issues like flooding and salinization of a quifers. Through exploitation of this DESSIN methodology, BdB expects to enable sales of EUR 1,000,000 annually over the next five years.
Improved and more efficient well-design and ASR-RO solution, key result of WP22.	Conventional ASR in the typical Westland saline aquifer results in ASR recovery efficiencies <30%. This can increase to efficiencies >50% with the inn ovative well design and even more by the use of RO. Thanks to the transformation of the Westland Demo site to a showcase (including information panels, accessibility, scale models, information video), over 500 people from over 20 different countries visited the Westland demo site during the DESSIN lifeti me. Since then, several initiatives have taken off to store different water sources in similar ways, such as treated waste water (reuse, Industry, public utilit ies, etc.), urban stormwater (public authorities, e.g. Rotterdam), surface water, and drainage water. Exploitation of such systems (during commencement, ex ecution, and for mainitaining the system) may be done through designated companies (e.g. site development companies) and give opportunities for specia lized SME's.
Market-ready advanced ASRRO sy stems, proven through demonstr ation activities in WP33 (D33.1 and D33.2)	The advanced ASRRO system showed to be capable of 1) enlarging the recovery of unmixed freshwater upon storage, 2) providing a more robust water supply thanks to the use of RO and 3) attaining a neutral water balance to prevent mining of water from a coastal aquifer. Demonstration of the effects and costs of ASRRO at the Westland site has supported convincing other individual greenhouse owners to implement ASR or ASRRO on their plots: around 11 ASR(RO) wells have been built since 2015 and around 12 are in the final design phase, which will result in an estimated turn-over for SME's of over 3.0 M€.
Solutions for clogging as a previou s limitation for broader application of ASR-RO (outcome of D22.3).	Clogging of membranes (and potentially: re-injection wells) during ASRRO appears to be driven by mobilization of clay particles and Fe-colloids. This can be mitigated by regular flushing of the RO-membranes with permeate and regular cleaning of the re-injection well. Maintenance of ASRRO systems may generally be done by specialized SME's. Solving this previous bottleneck will give a boost to the application of ASSRO (which has actually already started, see previous and following entry).
ASRRO ability to mitigate saltwa ter plume formation and be operat ed with a neutral to positive impact on the coastal groundwater system (outcome of WP22 and WP33).	The impact of widespread use of ASRRO on the regional Westland groundwater system was limited based on regional groundwater modelling, but it was shown that ASRRO decreased the chloride concentration with respect to the autonomous scenario and the use of brackish water reverse osmosis (BWRO). ASRRO was successful in mitigating the local negative impact (saltwater plume formation) caused by the deep disposal of membrane concentrate during BWRO. An overall positive to neutral impact of ASRRO on a coastal groundwater system is presumed, which is an improvement with respect to the use of BWRO in the same setting. ASRRO thus provides means to more sustainable use of coastal groundwater systems. Inspired by the succes of ASRRO as an example of a subsurface water solution, KWR and the Dutch engineering consultant Arcadis have set-up a Public-Private Partnership (Allied Waters, Co llab SALutions) to bring the knowledge to market. By 2018, this collab is staffed by 2-3 FTE.
A solution for real-time data monit oring and management for decen tralised water treatment units (out come of WP22 and WP34)	Remote, real-time data monitoring and management web platform, allowing operators to oversee the correct functioning of diverse waste-water processing. Measurements from the existing installations are displayed in the form of gauges, graphs and tables through a Responsive Graphical User Interface. These data can be exported in various data formats/files. An embedded alerting capability allows for the configuration of operator-defined event alerts. The operat or also has the option to perform analysis of historical data. This solution will be instrumental for future roll-out of the sewer-mining technology that was successfully demonstrated at Athens, and TELINt will explore transferability of this solution to other sectors (e.g. energy companies).
Proven and demonstrated concept and technology for sewer mining a nd decentralized water reuse (outco me WP22 and WP34)	The technological expertise and domain knowledge acquired through the DESSIN's Athen's sewer mining pilot will be turned into a consultation service a iming to support business and organizations related or interested in adapting and/or increasing exposure and use of water reuse technologies. The consultat ion services will also exploit software solutions related to decision support systems for the implementation and assessment of decentralized water reuse te chnologies at a city level. Characteristic examples of potential contractors are sewer and water companies, local authorities (e.g. municipalities) as well as medium and large industrial and touristic facilities that intent to turn into their operation towards a circular, environmental friendly scheme. Apart from the fact that the aforementioned activity is anticipated to create new job opportunities it would also bring significant "real-world" impact in bridging the gap

	between theoretical (i.e., pilot level) and practical developments.
Proven and demonstrated concept and technology for sewer mining and decentralized water reuse (outcome WP22 and WP34)	Building upon the research advances as well as the lessons learned from the DESSIN's Athen's sewer mining pilot, NTUA and EYDAP will improve and extend existing, university-level, educational material as well as create specialized lectures related with small/medium-scale decentralized urban reuse technologies. Among these, the technologies implemented at the DESSIN demo unit Membrane Bioreactor (MBR) and Reverse Osmosis (RO) will play a key role. Furthermore, it is intended to extend and establish, on a semester-basis, on-site educational field trips to the pilot site for graduate students. The field trips conducted throughout the project duration had a significant impact on triggering students' interest on new water reuse technologies as well as understanding for real-world and real-scale engineering works. Along these lines, the activities are anticipated to propagate newly-acquired state-of-the art knowledge and expertise to tomorrow's engineers and scientists. NTUA expects that about 40-50 students (20-25 graduate and more than 20 undergraduate) will participate in these specialist lectures and field trips per year.
Proven and demonstrated concept and technology for sewer mining and decentralized water reuse (outcome WP22 and WP34)	The DESSIN's Athens sewer-mining pilot demonstrated an innovative decentralized and modular solution for urban water use, which has triggered the interest of local municipalities and organizations in Greece and beyond. A characteristic achievement was the two awards obtained in the European Business Awards for the Environment. The pilot has already triggered further research developments since it allowed NTUA to obtain the permit to install a similar unit in the Natura protected area of Schinias, Greece; while it motivated the municipality of Athens and EYDAP (the Athen's water supply and sewage company) to participate in NextGen (a just approved H2020 research project) and to authorize the installation of a similar sewer mining unit in the urban area of Elaionas, Athens, Greece. The latter development is anticipated to harmonize decentralized urban water reuse technologies with the emerging scheme of circular economy. Finally, it has the potential to play a crucial rule in the uptake and widespread implementation of such engineering solutions. To provide a quantitative estimate, in the upcoming year, two pilot sewer mining units (DESSIN's and NextGen's) will be operational within the greater area of Athens, while this number is anticipated to grow as commercial companies will follow up and start implementing such schemes in an operational basis. Finally, from private contacts we are aware that two large hotel businesses that are operating in Messinia Greece and Elliniko, Athens, Greece are interested in installing such units (probably each one will install more than 2) within their facilities.
Tool for implementers to locate Managed Aquifer Recharge (MAR) systems in coastal areas with saline intrusion problems. This tool is based on a numerical model that allows show the main positive impacts of the technique helping to overcome implementation barriers (outcome WP22, in particular D22.5)	One of the barriers for MAR implementation is the doubt about the effectiveness of the measure. An easy and comprehensible numerical model allows to visualize the impacts over the groundwater resources when MAR system is implemented. This model can be used for any MAR implementer (water agency, water utility, regional administration,) to evaluate the positive impacts and the best location of the system in coastal aquifers. This tool can be used indefinitely. The commercial impact that is looked for with this tool is that the implementer that tries this tool would be probably interested in having a site-specific model to evaluate the impacts in a particular case. Hence, this tool aims to be a ramp for further developments. These kind of studies have an approximate value of between 30 000 and 50 000 €.
Public perception and evaluation of willingness to pay of Llobregat delta area inhabitants for environmental improvements (outcome WP35)	These results have shown that a relevant percentage of the population would understand a reasonable increase in their bill to support the environmental improvement of the coastal area. This conclusion is of relevance for water administration who has to find the formula to finance the implementation of measures like Managed Aquifer Recharge (MAR) that can help to improve related ecosystems. This evaluation can be aligned with the identification of other beneficiaries of MAR measures. The result has not a temporal deadline but it is recommended to finalize some action before 2 years as social conditions can change. The impact of this conclusion has to be evaluated through the implementation of the measure which can have a cost an inversion cost of 0.8 million €.
Working group with local stake holders of Llobregat Delta aquifer to foster implementation of DESSIN results at real-scale (outcome WP35 activities)	A working group with local stakeholders of Llobregat Delta aquifer was created within the project, and it is planned to continue working in order to assure the project results implementation in a real-scale. The working grup is composed of Cetaqua, Aigües de Barcelona, Llobgregat Delta Aquifer Users Community, Catalan Water Autority and Catalan Health Department. The working group meetings will continue in order to assure the application of pre-potable water injection demonstrated in DESSIN by the permit and authorization of responsible public bodies. This will start right now and contine at least until real implementation in 2020-2021, by Cetaqua, Aigues de Barcelona, Llobgregat Delta Aquifer Users Community, Catalan Water Autority and Catalan Health Department. The potential impact is the water resource increase for Barcelona metropolitan area in 8.3 Hm^3/year (estimated from the average injected water between 1990-1995).
Proven and demonstrated concept and technology to inject pre-pota	After the demonstrated beneficial application of pre-potable water for aquifer direct recharge, Aigues de Barcelona as a site owner and operator of Aquifer Storage and Recovery system it is willing to apply it in a real scale in 2020/2021, when the facility will be prepared and public authorities will have given t

ble water for aquifer direct recharge (key result WP35).	he permit.The potential impact is: considering the average injected water in this aquifer storage and recovery site within the years with maximum volumes (1990- 1995, 8.3 Hm³/year) and the difference between previous potable water injected (0,2 €/m³) and future sand filtered water injection (0,06 €/m³), the demonstrated innovation will save 1M€/year to the water operator.
Monitoring and Evaluation Criteria and Indicators important for applicability of innovative water technologies (D42.5)	By knowing more about the Monitoring and Evaluation Criteria and Indicators important for applicability of innovative water technologies we can support the development of technologies that are better suited to the current requirements and thus better applicable and feasible. On the other side we can provide better support to the development of policy recommendations regarding the required legal frameworks which incentivise innovative water technologies. The additional gained knowledge only adds up to existing knowledge and thus further improves ongoing activities. Knowledge gained in the Dessin project is already being applied e.g. in the SUBSOL project where legal and policy framework analyses have lead to policy briefs providing policy recommendations. The impact could possibly be a further uptake of innovative water technologies, especially those which have a positive impact on eco system services.
Consultancy Service and providing capacity building to SMEs on commercialising and maturing innovative water technologies (D42.2)	The developed methodologies of consulting and building capacities within SMEs on commercialisation and maturing their innovative water technologies can be used in further upcoming consultancy activities in the water sector. Adelphi together with academic partners currently develops follow up research and innovation projects in which innovative water technologies are being further developed. Involved technology provider can benefit from the methodologies developed under Dessin. The impact could be that the technology provider can develop their technologies better suiting the requirements and meeting market demand.

4.3 Report on societal implications

B. Ethics

1. Did your project undergo an Ethics Review (and/or Screening)?	No
If Yes: have you described the progress of compliance with the relevant Ethics Review/ Screening Requirements in the frame of the periodic/final reports?	

2. Please indicate whether your project involved any of the following issues :

RESEARCH ON HUMANS

Did the project involve children?	No
Did the project involve patients?	No
Did the project involve persons not able to consent?	No
Did the project involve adult healthy volun teers?	No
Did the project involve Human genetic materi al?	No
Did the project involve Human biological samples?	No
Did the project involve Human data collec tion?	No

RESEARCH ON HUMAN EMBRYO/FOETUS

Did the project involve Human Embryos?	No
Did the project involve Human Foetal Tissue / Cells?	No
Did the project involve Human Embryonic Stem Cells (hESCs)?	No
Did the project on human Embryonic Stem Cells involve cells in culture?	No
Did the project on human Embryonic Stem Cells involve the derivation of cells from Em bryos?	No

PRIVACY

Did the project involve processing of genetic information or personal data (eg. health, sexu al lifestyle, ethnicity, political opinion, reli gious or philosophical conviction)?	No
Did the project involve tracking the location or observation of people?	No

RESEARCH ON ANIMALS

Did the project involve research on animals?	No
Were those animals transgenic small laboratory animals?	No
Were those animals transgenic farm animals?	No
Were those animals cloned farm animals?	No
Were those animals non-human primates?	No

RESEARCH INVOLVING DEVELOPING COUNTRIES

Did the project involve the use of local resources (genetic, animal, plant etc)?	No
Was the project of benefit to local community (capacity building, access to healthcare, education etc)?	Yes

DUAL USE

Research having direct military use	No
Research having potential for terrorist abuse	No

C. Workforce Statistics

3. Workforce statistics for the project: Please indicate in the table below the number of people who worked on the project (on a headcount basis).

Type of Position	Number of Women	Number of Men
Scientific Coordinator	0	1
Work package leaders	8	14
Experienced researchers (i.e. PhD holders)	50	80
PhD student	4	6
Other	20	48

4. How many additional researchers (in companies and universities) were recruited specifically for this project?	20
Of which, indicate the number of men:	8

D. Gender Aspects

5. Did you carry out specific Gender Equality Actions under the project ?	No

6. Which of the following actions did you carry out and how effective were they?	
Design and implement an equal opportunity policy	Not Applicable
Set targets to achieve a gender balance in the workforce	Not Applicable
Organise conferences and workshops on gender	Not Applicable
Actions to improve work-life balance	Not Applicable
Other:	

7. Was there a gender dimension associated with the research content - i.e. wherever people were the focus of the research as, for example, consumers, users, patients or in tri als, was the issue of gender considered and ad dressed?	No
If yes, please specify:	

E. Synergies with Science Education

8. Did your project involve working with stu dents and/or school pupils (e.g. open days, participation in science festivals and events, prizes/competitions or joint projects)?	Yes
If yes, please specify:	at several DESSIN demo sites, there were organ ised visits for schools, students and pupils groups

9. Did the project generate any science educa tion material (e.g. kits, websites, explanatory booklets, DVDs)?	Yes
If yes, please specify:	The project generated a portfolio of videos useable for educational purposes and to inform the broader (non-scientific) public

F. Interdisciplinarity

10. Which disciplines (see list below) are involved in your project?	
Main discipline:	2.1 Civil engineering (architecture engineering, building science and engineering, construction en gineering, municipal and structural engineering and other allied subjects)
Associated discipline:	1.4 Earth and related environmental sciences (geology, geophysics, mineralogy, physical geo graphy and other geosciences, meteorology and

	other atmospheric sciences including climatic re search, oceanography, vulcanology, palaeoeco logy, other allied sciences)
Associated discipline:	5.2 Economics

G. Engaging with Civil society and policy makers

11a. Did your project engage with societal act ors beyond the research community? (if 'No', go to Question 14)	Yes
11b. If yes, did you engage with citizens (citizens' panels / juries) or organised civil so ciety (NGOs, patients' groups etc.)?	Yes - in implementing the research
11c. In doing so, did your project involve act ors whose role is mainly to organise the dia logue with citizens and organised civil society (e.g. professional mediator; communication company, science museums)?	Yes
12. Did you engage with government / public bodies or policy makers (including interna tional organisations)	Yes - in implementing the research agenda
13a. Will the project generate outputs (expertise or scientific advice) which could be used by policy makers?	Yes - as a secondary objective (please indicate areas below - multiple answer possible)
13b. If Yes, in which fields?	
Agriculture	Yes
Audiovisual and Media	No
Budget	No
Competition	No
Consumers	Yes
Culture	No
Customs	No
Development Economic and Monetary Affairs	No
Education, Training, Youth	No
Employment and Social Affairs	No
Energy	No
Enlargement	No
Enterprise	No
Environment	Yes
External Relations	No
External Trade	No
Fisheries and Maritime Affairs	No

Food Safety	Yes
Foreign and Security Policy	No
Fraud	No
Humanitarian aid	No
Human rightsd	No
Information Society	No
Institutional affairs	No
Internal Market	No
Justice, freedom and security	No
Public Health	Yes
Regional Policy	Yes
Research and Innovation	Yes
Space	No
Taxation	No
Transport	No
13c. If Yes, at which level?	Local / regional levels

H. Use and dissemination

14. How many Articles were published/accep ted for publication in peer-reviewed journals?	13
To how many of these is open access provided?	13
How many of these are published in open ac cess journals?	9
How many of these are published in open re positories?	4
To how many of these is open access not provided?	0
Please check all applicable reasons for not providing open access:	
publisher's licensing agreement would not per mit publishing in a repository	No
no suitable repository available	No
no suitable open access journal available	No
no funds available to publish in an open access journal	No
lack of time and resources	No
lack of information on open access	No
If other - please specify	
15. How many new patent applications ('priority filings') have been made?	1

("Technologically unique": multiple applications for the same invention in different jurisdictions should be counted as just one application of grant).	

16. Indicate how many of the following Intellectual Property Rights were applied for (give number in each box).	
Trademark	0
Registered design	0
Other	0

17. How many spin-off companies were created / are planned as a direct result of the project?	0
Indicate the approximate number of additional jobs in these companies:	0

18. Please indicate whether your project has a potential impact on employment, in comparison with the situation before your project:	Increase in employment, In small and medium-sized enterprises

19. For your project partnership please estimate the employment effect resulting directly from your participation in Full Time Equivalent (FTE = one person working fulltime for a year) jobs:	20

I. Media and Communication to the general public

20. As part of the project, were any of the beneficiaries professionals in communication or media relations?	Yes

21. As part of the project, have any beneficiaries received professional media / communication training / advice to improve communication with the general public?	Yes

22. Which of the following have been used to communicate information about your project to the general public, or have resulted from your project?	
Press Release	Yes
Media briefing	No
TV coverage / report	Yes
Radio coverage / report	No
Brochures /posters / flyers	Yes
DVD /Film /Multimedia	Yes
Coverage in specialist press	Yes
Coverage in general (non-specialist) press	Yes
Coverage in national press	Yes

Coverage in international press	No
Website for the general public / internet	Yes
Event targeting general public (festival, con ference, exhibition, science café)	Yes

23. In which languages are the information products for the general public produced?	
Language of the coordinator	Yes
Other language(s)	Yes
English	Yes

Attachments	22-DESSIN-final-report-narrative-2018-03-16.pdf
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Name	
Date	23/03/2018

This declaration was visaed electronically by David SCHWESIG (ECAS user name nschweda) on 23/03/2018