# DESSIN

## ANNUAL MAGAZINE 2016

# 01 | The Water Framework Directive at DESSIN's Emscher site

## The Water Framework Directive at DESSIN's Emscher site

The Emscher restoration process, which was initiated in 1990 and is ongoing until 2020, aims at restoring the Emscher river and its tributaries. Initial reason for the restoration was to retransform the manmade system of open wastewater conducts in accordance with the state of the art. The European Water Framework Directive (WFD) has been put in place only in the year 2000 but its goals coincide with the goals of the restoration. However, due to the intensive human activities in the Ruhr area, most streams within the Emscher basin are heavily modified water bodies according to the WFD and their restoration is hampered by factors like space restriction, transverse structures, contaminated soils, and ground subsidence. Furthermore, combined sewer overflow facilities – an ongoing water management necessity – can have effects on the freshwater ecosystem.

Deininghauser Bach before (left) and after (right) restoration (Author: Thomas Korte)

## Development of Deininghauser Bach

The tributary "Deininghauser Bach" was restored stepwise between 1992 and 2001, the upstream part being now 21 years after restoration. The biology has developed well in this upstream part: 419 terrestrial and aquatic animal and plant species were counted in 2011, 43 of which are endangered species. The ecological potential has developed to very good and good in the headwaters while being poor at lower sections. This is due to the poor structure in these stream sections located in a dense urban area. Thus, the ecological potential has developed very differently in the single sections.
Furthermore, it has been demonstrated that even in sections with high chances of improvement, at least 9-10 years are required for the development of a mature species community, which indicates the good potential. At the moment, single restored stream sections are still in isolation from other streams which limits the chances of recolonization by species and prolongs the development process. Once these sections are connected to a joint network, the number of species is expected to increase further due to dispersal.

These examples show that some sections can develop to good status after several years, while others are restricted in their development due to various constraints. However, even if these sections cannot achieve the good potential, the restoration can still be very valuable in the broader sense of ecosystem services going beyond the WFD related indicators for biodiversity and habitat.

# 01 | The Water Framework Directive at DESSIN's Emscher site

## Where DESSIN comes into play

In DESSIN, the Emscher catchment serves both as mature and demo case:

In the mature case, the change in ESS provision resulting from the Emscher reconversion is assessed with the help of DESSIN's ESS Evaluation Framework. The assessment focuses on regulating services with respect to nutrient retention and flood protection, cultural services such as recreation, as well as economic aspects created by an enhanced attractiveness of the region.

Upper reach of the Emscher after restoration (Thomas Korte)

In the demo case, innovative cleaning and controlling techniques are tested in combined sewer overflow facilities along the upper reach of the Emscher. Their goal is to further reduce the amount of combined sewage released into restored streams during heavy rain events. By decreasing this occasional pressure, the state of the ecosystem is expected to increase, which can augment the provision of ESS, for example regulating services such as biodiversity & habitat provision and the self-purification potential of streams. These, in turn, have an impact on the provision of cultural services.

Concluding, the ESS concept can be utilized in addition to the WFD's view on ecosystem integrity because it incorporates also nature's use by humans, which is - especially in urban surroundings - unavoidable or even desired. In combination with the WFD, it is an important instrument for assessing the success of restoration measures, for political decision making, management and planning processes.

# 02 | Successful implementation and future work of the Ecosystems Services concept in the water sector

## DESSIN's research

The DESSIN project researches how to evaluate the pros and cons of these environmental solutions. Currently, in Europe, there are many simultaneous initiatives working in this same field, which creates synergies between workgroups. Specifically, the DESSIN project is linked to the Ecosystem Services for Europe (ESE) Action Group with a number of other ongoing projects.

The DESSIN sites Llobregat, Emscher and Aarhus are three areas where environmental solutions have already produced measurable benefits for citizens, industries and water managers. In the case of the Llobregat River in Spain, the use of groundwater as a reserve stimulates greater water supply guarantee and increases aquatic biodiversity in the lower Llobregat River when it flows into infiltration ponds. By restoring the Emscher in Germany, locals who had to deal with a highly polluted river for a long time are now able to appreciate the river again. Furthermore, the restored Emscher streams provide the services of flood protection and self-purification. In Aarhus in Denmark, after the river was restored, it once again became a popular part of the city. Currently, it is a meeting point that promotes leisure and recreational services with cafés and restaurants.

Presently, the challenge within these three case studies is to test the DESSIN ESS Valuation Framework developed by DESSIN's expert economists, sociologists, biologists and hydrologists. This testing and validation takes place in terms of assessing both the environmental impact and economic benefits of the solutions implemented at the sites.
Some challenge the idea of putting a price tag on nature. However, the ultimate goal of the DESSIN project is not to give ecosystem services an economic value, but to consider the various problem-solving strategies to make better-informed decisions based on more rigorous and standardized methods.

# 02 | Successful implementation and future work of the Ecosystems Services concept in the water sector

## Successful implementation and future work of the Ecosystems Services concept in the water sector

Understanding the concept of Ecosystem Services (ESS) and what the environment can do for us is crucial for considering nature-based solutions as feasible investment options. In the water sector, one of the most famous cases is New York City in 1997, where politicians had to decide about an investment plan that would guarantee drinking water for the citizens. Their options were: 1) a restructuring and expansion of treatment plants that amounted to $6 billion expenditure, or 2) an investment in watershed protection (tree planting, setting up protection zones, etc.) which would cost $1.5 billion. The decision was made to improve the environment and protect nature.

So in 1997, New York City embarked on a monumental plan to buy thousands of upstate acres, shield its reservoirs from pollution, improve treatment plants and septic systems and subsidize environmentally sound economic development[1].

In Europe, Vittel Mineral Water is a pioneering example for understanding the value of ESS. This firm has shown that it is possible for seemingly conflicting activities like agriculture and mineral water bottling to take place in the same location. By setting up agreements that control the use of fertilizers and promote good farming practices, the watershed was protected and the production of commercial drinking water became economically feasible. Dialogue between the farming community and Vittel began in 1989, through the establishment of Agriculture-Environment-Vittel (AGREV). Farmers were invited to participate in research identifying acceptable conditions for a new production system. In 1992, Nestlé Waters created Agrivair to act as an intermediary. Farmers were incentivised to discontinue maize cultivation for animal feed, adopt extensive cattle ranching, replace agrochemicals with composted manure, and modernise farm buildings to reduce leaching of animal waste. As a result water quality has been maintained. Thus, the groundwater has an added value, which translates into benefits for the water company. In turn, these benefits are reinvested in the promotion of more sustainable use of fertilizers, the endorsement of permeable surfaces over sealed surfaces and the improvement of farm slurry management to avoid the contamination of aquifers[2].

1 More information in: http://www.ecosystemmarketplace.com/articles/ecosystem-services-in-the-new-york-city-watershed-1969-12-31/

2 More information and additional examples: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/200901/pb13932a-pes-bestpractice-annexa-20130522.pdf

# 03 | Demo Site progress

## Demo Site's Characteristics

### WESTLAND (Netherlands)

In Westland, main focus is on Aquifer Storage and Recovery (ASR) studies. The Waterbuffer Showcase in the Greenport Westland demonstrates how innovative, small-scale ASR in combination with desalination can be used to safeguard a sustainable fresh water supply in coastal areas. Within the DESSIN project, the potential to further improve the recovery of rainwater surpluses after storage in brackish aquifers is demonstrated.

### LLOBREGAT (Spain)

In Llobregat aquifer, DESSIN's innovation focuses on aquifer replenishment using pre-potable water. During the project, the evaluation of hydrogeochemical impacts in the aquifer is being done at the pilot (column experiment) and at a demonstrative scale, using a dual injection-recovery well in the drinking water treatment plant of Sant Joan Despí (Barcelona).

### HOFFSELVA (Norway)

In the Hoffselva catchment, DESSIN's innovations focus on advanced local treatment of combined sewer overflow (CSO) in order to reduce the impact on water quality in the Hoffselva River. This can facilitate the WFD implementation in the Hoffselva catchment and also contribute to improved water quality in the Oslo Fjord.

### EMSCHER (Germany)

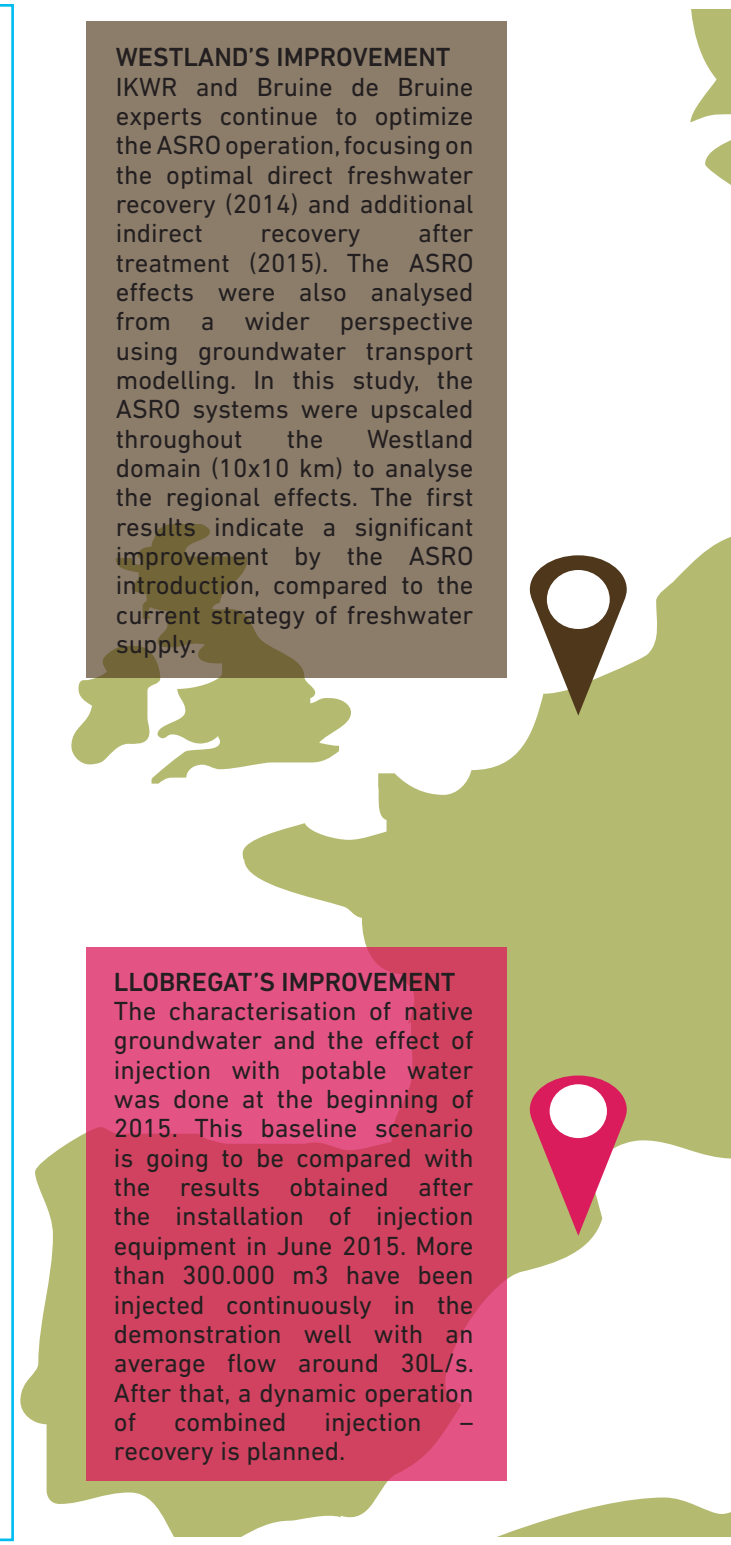
In the Emscher catchment, DESSIN's innovations focus on advanced treatment and reduction of combined sewer overflow (CSO) in order to reduce the impact on recipient water quality, and thus, to support the Emscher re-conversion process. This can facilitate the Water Framework Directive (WFD) implementation for the heavily modified water bodies and contribute to increased values of ecosystem services.

### ATHENS (Greece)

The Athens pilot site focuses on innovative management options and technologies to support distributed reuse in large urban areas. The demonstration looks into sewer mining, as a novel concept for distributed reuse exploiting state-of-art information and communication technology (ICT) solutions for distributed monitoring and management and explores new membrane solutions and technologies in the form of modular packaged treatment solutions.

**WESTLAND'S IMPROVEMENT**

IKWR and Bruine de Bruine experts continue to optimize the ASRO operation, focusing on the optimal direct freshwater recovery (2014) and additional indirect recovery after treatment (2015). The ASRO effects were also analysed from a wider perspective using groundwater transport modelling. In this study, the ASRO systems were upscaled throughout the Westland domain (10x10 km) to analyse the regional effects. The first results indicate a significant improvement by the ASRO introduction, compared to the current strategy of freshwater supply.



**LLOBREGAT'S IMPROVEMENT**

The characterisation of native groundwater and the effect of injection with potable water was done at the beginning of 2015. This baseline scenario is going to be compared with the results obtained after the installation of injection equipment in June 2015. More than 300.000 m3 have been injected continuously in the demonstration well with an average flow around 30L/s. After that, a dynamic operation of combined injection – recovery is planned.

# 03 | Demo Site progress

**HOFFSELVA'S IMPROVEMENT**
A high rate filter unit developed by Inrigo AS, a Norwegian SME, has been installed at Hoffselva in 2015 and is currently being tested during CSO-overflow events. The pilot filter is located in a movable container and is fed by the combined sewer system. Removal efficiency for particulate matter is continuously monitored by on-line measurements of turbidity. Water samples are in addition analysed for additional water quality parameters, including chemical and biological oxygen demand and phosphorous concentrations.

*Combined Sewer Overflow (CSO)*

**EMSCHER'S IMPROVEMENT**
In June 2015 a cross-flow lamella settler, developed by UFT, was experimentally employed at a CSO facility in Castrop-Rauxel, operated by EG. The pilot unit is located in a movable container and is fed by the combined sewer system. The pilot unit will be operated until June 2016 and subsequently be shipped to Norway for testing at the Hoffselva site, based on the experiences made at the Emscher site.

*The cross-flow lamella settler*

**ATHEN'S IMPROVEMENT**
Since December 2015, Telint and NTUA have developed an intelligent software-hardware platform. The communication solution allows collection, processing and data visualization of the field sensors installed at the packaged plant. The platform incorporates OGC standards, which enables interoperable data representation and alert rules, while the user interface enables real-time access and display of the sensor data and alerts. The communication solution implemented supports the need of local and remote control and monitoring of the field sensors installed.

# 04 | Interview with Durk Krol: "The most challenging task is to successfully bring the innovations to society and market"

**Durk Krol is the current director of the WssTP (European Technology Platform for Water Research and Innovation). The mission and related objectives of the WssTP are to strengthen the competitiveness and the potential for technological innovation of the European Water Industry. The WssTP will meet global challenges and regional demands to ensure safe, secure and sustainable water and sanitation services, for the benefit of society and the environment, within the framework of integrated water resources management.**

**The DESSIN project has completed its second year. What is your perception of the project? How do you think it is evolving?**

The project has a number of good examples on how to address water scarcity and water quality. It has also smartly selected demo sites with innovative technologies and applies an open innovation principle. DESSIN has a solid variability of different carefully selected actors and end-users, and there is a concrete role for local stakeholder groups to play. This is a very positive point as these actions directly support the local authorities involved in the river basin management defining programmed of measures for the Water Frame Directive (WFD).

A very innovative point of the project is that it provides the methodology to give the value of ecosystems services (ESS) that act as a driving force for further incentives of innovations to address water scarcity and water quality challenges.

**What key characteristics does DESSIN have for someone outside the project?**

DESSIN has two explicit characteristics: The first one is the demonstration of a methodology for the valuation of ESS as catalyser for innovation. The second is that the project strives to show how innovative solutions in the water cycle can increase the value of the services provided by freshwater ecosystems.

The project also provides a good combination of selected technological solutions, an assessment on case-by-case basis with demonstrations, and a systemic approach to link those into a decision support tool to support local authorities and increase incentives for business developments on ESS. Moreover, it sufficiently covers different geographic regions via its consortium partners, thus addressing different climatic conditions and different population densities.

***"DESSIN contributes to the climate change challenges towards a smart sustainable integrated water management"***

**To which extent is DESSIN different from other projects?**

The advanced ESS approach and the methodology proposed by the project enables a monetary valuation of the impact of water management measures, which is a novelty of the project. DESSIN applies a very clear definition of ESS that could be directly taken by the European Commission WFD interpretation everywhere in Europe. Furthermore, it clearly defines the framework for ESS and is striving to propose concrete guidance for businesses to create new incentives, combining them with the support to comply with the WFD and other core water policy objectives for the environment, quality of life and society.

**The Water Framework Directive has reached its final year of implementation . How do you think the DESSIN project results will help ?**

WFD implementation ambition of 2015 is achieved only by half. Thus the work on reaching completely the objectives is lagging far behind and needs intensification of efforts. Without innovative solutions with an open innovation approach the ambitions cannot be achieved for Europe. The results of the project could be used to contribute concretely to implement programmes of measures of river basin management plans addressing water quality challenges. Secondly, DESSIN results could be used to deal with water scarcity, contributing to the climate change challenges towards a smart and sustainable integrated water management.

**What are the challenges you see for the second half of DESSIN?**

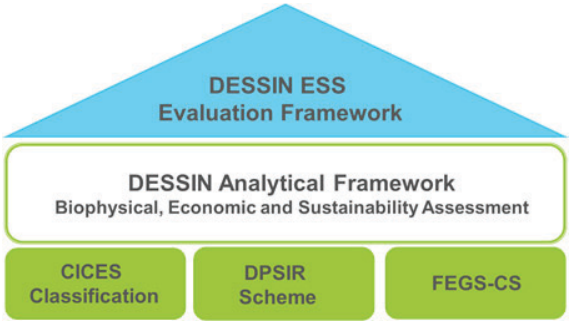
First of all, to develop and finalize the Ecosystem service valuation toolkit with a user-friendly software module and to finalize ready-to-market-uptake technological solutions for e.g. Combined Sewer Overflows real-time management or sewer mining technologies for water reuse. The most challenging project task is to successfully bring the innovations to society and market, as well as to ensure that project achievements are understood and supported by the decision-makers that can practically take up the solutions and put them into the programme of measures of the river basin management plans.

# 05 The DESSIN ESS Evaluation Framework

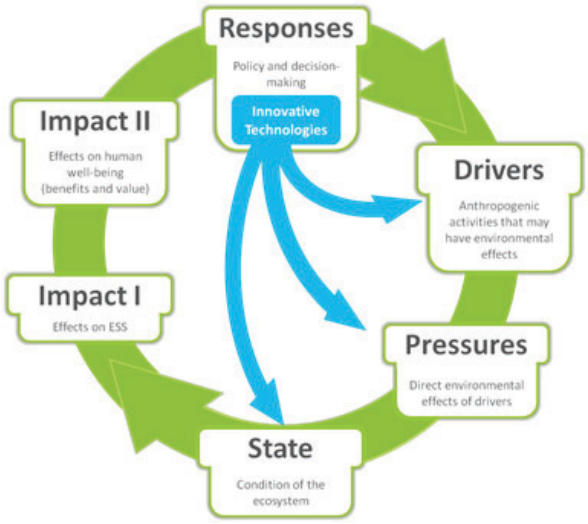
**A framework for the assessment of changes in fresh water ecosystem services that will lead to innovation has been tested**

New solutions and advancements in technology are necessary to meet the water quality and scarcity challenges that Europe faces. However, innovations commonly meet a series of barriers to their implementation. To enable decision makers to incorporate broader environmental and economic aspects when evaluating the costs and benefits of investing in novel solutions can help to overcome these barriers. The applied framework and key contribution of DESSIN, the DESSIN Ecosystem Services (ESS) Evaluation Framework, uses an integrated methodology for the evaluation of changes in the ESS. The framework is at its latest stage of development, which includes its testing at the Mature Sites of the project.

The DESSIN ESS Evaluation Framework was developed on the basis of the Common International Classification of Ecosystem Services (CICES) and the Driving Forces, Pressures, States, Impacts and Responses (DPSIR) adaptive management cycle. Furthermore, the framework will be accompanied by a sustainability assessment module, which will help to ensure a holistic perspective for the evaluation.




Components and foundations of the DESSIN ESS Evaluation Framework.




Conceptual approach of the DESSIN ESS Evaluation Framework (based on Müller and Burkhard, 2012, Van Oudenhoven et al., 2012 and Haines-Young and Potschin, 2010; 2013).

In the DPSIR scheme as applied in DESSIN, the innovative technologies to be tested within the project are considered Responses that may have influence on Drivers (anthropogenic activities with environmental effects), Pressures (the direct effects of such activities) and States (the conditions of the ecosystems under study). From the resulting changes in ecosystem state, the changes in ESS (Impact I) will be estimated. An economic assessment of the subsequent changes in the benefits as perceived by society and in the value of the services derived from ecosystems (Impact II) will follow. Finally, this estimated change in the level of human well-being will inform policy and decision-making (further Responses).

The first applications of the DESSIN ESS Evaluation Framework are taking place in the mature sites of the Emscher, the Aarhus and the Llobregat rivers. Here, the effects of the different types of interventions that have been conducted in the past are being appraised. This testing phase is designed to fine-tune and validate the methodology and to help clarify the process of its practical application. It is also intended to clarify the intricate concepts that are built into the framework and that so frequently represent barriers to the application of ESS Approach.

# 06 First stygofauna sampling survey in the Llobregat area

Cetaqua, jointly with University of Girona, are carrying out stygofauna sampling campaigns in the aquifer of the lower basin of the Llobregat River. Different conditions of managed aquifer recharge have been selected: The demonstration site of the project (injection well), infiltration ponds, and aquifer observation wells near the Llobregat river. This is not the core task of the demonstration site, but will complement the results and will bring some additional characterisation to the studied aquifer.

The aim of this work is to find out about the stygofauna living in the Llobregat aquifer, since stygofauna may be used as an environmental quality indicator of groundwater aquatic ecosystems. Stygofauna is a reserve of biodiversity, it keeps the aquifer interstitial spaces clean, changes redox gradients and promotes activity of biofilms. The most important value of stygofauna in this case is that their presence and their spatial and time variations may indicate the status and changes in the groundwater aquatic ecosystem. Current results will be compared with future campaigns in 2016 with different environmental and recharge conditions.

**Stygofauna** are aquatic animals that live in groundwater. Globally, stygofauna are found in many different types of groundwater environments including fresh and saline aquifers, caves in limestone, and within the smaller pore spaces, voids, cracks and fissures in virtually any other type of rock or sediment, including springs and sediments in the beds of streams and rivers. Most stygofauna are invertebrates, predominantly species of crustaceans, but also worms, snails, water mites and diving beetles, while others are vertebrates (for instance, fishes or even amphibians). Some species of stygofauna are specially adapted to underground life, and are typically blind and pale with elongated appendages to help them navigate in complete darkness.

Amphiphod specimen sample

The first sampling campaign was scheduled for October and November 2015 and the process is not an easy task. An inertia pump is used to extract 300L of each bore. This water volume is filtered in the field, using 50 mm mesh sieves which retain stygofauna. These samples are preserved using 100% ethanol. Moreover, physicochemical parameters of the water are also analysed in the same place, using field probes. And finally, water samples are taken for nutrient and major ion analysis.

Experts from the University of Girona will analyse the samples of stygofauna and soon more characteristics will be known of groundwater aquatic ecosystems in the lower basin of the Llobregat and its relation with aquifer recharge. One of the specimens viewed is an amphipod.

DESSIN's researchers working on the field

# 07 | Partners

The DESSIN project is formed by 21 partners from seven different European countries, led by the German company IWW.

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DESSIN

DEMONSTRATE ECOSYSTEM SERVICES ENABLING INNOVATION IN THE WATER SECTOR

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