



## **LIFE Integrated Projects 2016**

### **Optimising the implementation of the 2<sup>nd</sup> RBMP in the Malta River Basin District**

**LIFE 16 IPE MT 008**



#### **Action A.3:**

***Report showcasing research initiatives of relevance to water management in  
the Maltese Islands***

## Introduction

Action A.3 is one of the 9 Preparatory Actions under the LIFE Integrated Project. Like other Preparatory Actions, Action A.3 is intended to facilitate the implementation of subsequent Concrete Actions which are to be implemented in the later phases of the LIFE Integrated Project. More specifically, under Action A.3, each of the 18 Concrete Actions, several related projects, implemented either locally (in Malta) or abroad, were identified. Under this action, information about these related projects was compiled into a catalogue, which serves as an information base necessary to support the implementation of the Concrete Actions.

This catalogue is being presented in two formats: this report is one of these formats; the second format is an online catalogue available on the website dedicated to the LIFE 16 IPE MT 008 project (<https://www.rbmplife.org.mt/eu-projects>).

The Energy and Water Agency (EWA) is responsible for coordinating Action A.3 and compiling this catalogue. However, Action A.3 is a horizontal action which encompasses all 18 Concrete Actions. This includes actions which are not being led by EWA but by the other LIFE IP beneficiaries. In view of this, the Agency made an effort to create synergies with the other beneficiaries, so that each beneficiary could identify projects related to the Concrete Actions being led by it.

This document contains 18 sections, one for each Concrete Action. Each section further contains a brief description of the Concrete Action, and one or more related projects, as identified by the LIFE IP beneficiary leading the relevant action.

## Action C.1: Household Water Consumption Audits

### Brief Description of the Concrete Action

The sole beneficiary for this action is EWA who will be responsible for the overall coordination and implementation of the action.

The action is intended to increase awareness to households about the lower water consumption rates which can be achieved through increased conservation and efficiency in water use. Also, the action intends to link water consumption with energy consumption to make households more aware that water consumption carries also an energy footprint; and thus increased water conservation will optimise household energy consumption and reduce its carbon footprint. This is of particular relevance, given that surveys undertaken by the National Statistics Office have shown that around 30-35% of energy used by households goes towards the heating of consumed water.

The action intends to carry out a nationwide campaign wherein households will be visited by water and energy consumption auditors, trained under the action itself. In this regard, the intention is to carry out two visits to each interested household. The first visit will introduce the project, provide the occupier with useful generic tips on water consumption optimisation and entice the occupier in participating in a more detailed audit which would be undertaken during the second visit.

In the first visit, which is expected to last around 15 minutes, the occupier will be introduced to the scope of the action and informed about the water consumption audit which will be carried out during the second visit. In order to increase interest in the action's second visit, a gift pack with a kitchen faucet water aerator (bearing the LIFE Programme and LIFE IP Logo) shall be distributed to households participating in this first visit; together with a leaflet providing a series of simple water saving tips for optimising household water use efficiency.

The second visit is expected to last around 1 hour where a full water audit of participating households will be undertaken, giving advice on water conservation and the efficient use of water consuming appliances within the building envelope. This visit will also tie in with the complementary actions under the National Water Conservation Campaign and will distribute a water saving kit (envisaged to be financed under Cohesion Funds) to all the participating households. The auditors will explain to the households how the devices included under the water saving kit can be fitted and used effectively. Participating households will also be asked to fill in a questionnaire about their water using patterns.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.1: Household water consumption audits
Project Title:	Sustainable domestic Water Use in Mediterranean Regions
Project Acronym/ID:	SWMED
Project Duration:	2011 - 2014
Project Status:	Completed
Funding Programme:	<ul style="list-style-type: none"> <li>2007 - 2013 Mediterranean Sea Basin ENPI CBC</li> </ul>
Key Contacts:	Contact Person 1: Name: Not Available Email: <a href="mailto:adrage@regione.lazio.it">adrage@regione.lazio.it</a> Institution: Region of Latium
<u>Project Summary</u>  The whole Mediterranean area is characterised by a strong need of new solutions able to provide sanitations services while reducing water use and wastewater discharge. The SWMED project focuses on optimising the per capita water consumption at household and urban level through the implementation of water saving devices, reuse of treated wastewater, rainwater harvesting, and a pool of technologies collectively known as Sustainable Water Management (SWM). The project has achieved the stated objectives primarily by the installation of Sustainable Water Management (SWM) in demonstration houses during house visits.	
Descriptive keywords:	‘Water management’ ‘New products and services’ ‘Sustainable management of natural resources’
Project Website:	
<u>Key Deliverables/Publications and Links</u>  <a href="https://www.keep.eu/keep/project-ext/10834/SWMED?ss=3d3626826ba7d857bdc4d38ea697aef2&amp;espon">https://www.keep.eu/keep/project-ext/10834/SWMED?ss=3d3626826ba7d857bdc4d38ea697aef2&amp;espon</a>	

Relevant LIFE IP Concrete Action:	Action C.1: Household water consumption audits
Project Title:	In-home Water Use Audit Project
Project Acronym/ID:	IHWA
Project Duration:	Not Available
Project Status:	Completed
Funding Programme:	Not Available
Key Contacts:	Contact Person 1: Name: Not Available Email: Waterwise@rsb.gov.ae Institution: Waterwise
<p><u>Project Summary</u></p> <p>The project was commissioned to achieve the following objectives:</p> <ul style="list-style-type: none"> <li>• Broaden baseline data by investigating the causes of high water consumption in the residential sector.</li> <li>• Determine the potential for water saving opportunities in such homes.</li> <li>• Promote positive behavioral change and help Abu Dhabi residents appreciate the real value of water resources, reduce wastage and increase end use efficiency.</li> </ul> <p>The project targeted residents of Abu Dhabi and Al Ain living in villas and Shaabbias whose consumption was in the red band (greater than 7000 L/day).</p> <p>The project consisted of the following stages:</p> <p>Phase 1: involved recruiting 45 participating homes from a pre-selected list of high water consuming properties in Abu Dhabi and Al Ain.</p> <p>Phase 2: involved conducting detailed surveys and water use audits for the 45 participating homes. The surveying and auditing exercised comprised the following activities:</p> <ul style="list-style-type: none"> <li>- Irrigation and landscape audit</li> <li>- Consumer behavioral survey</li> <li>- Plumbing audit</li> </ul> <p>Phase 3: involved analysing the gathered information and generating statistics on household water usage estimates and patterns.</p> <p>Phase 4: the data analysis phase provided better understanding on water usage in the studied homes and determined the potential for water saving opportunities. Summary reports on current water use breakdown in the studied homes, together with water saving recommendations were provided to the residents to encourage the adoption of Waterwise measures in their homes.</p>	
Descriptive keywords:	'Household water consumption' 'Awareness'

Project Website:	<a href="http://www.waterwise.gov.ae/en/research/research-studies/in-home-water-use-audit-project.html">http://www.waterwise.gov.ae/en/research/research-studies/in-home-water-use-audit-project.html</a>
<u>Key Deliverables/Publications and Links</u>	
<a href="http://www.waterwise.gov.ae/en/research/research-studies/in-home-water-use-audit-project.html">http://www.waterwise.gov.ae/en/research/research-studies/in-home-water-use-audit-project.html</a>	

Relevant LIFE IP Concrete Action:	Action C.1: Household water consumption audits
Project Title:	Research of domestic water consumption: a field study in Harbin, China (Research Project)
Project Acronym/ID:	Not Applicable
Project Duration:	September, 2007 (Date of Publication)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Tingyi Lu Email: Not Available Institution: Loughborough University

#### Project Summary

The aim of this project was to understand current household water use behaviour and water use patterns in Harbin, North of China, to improve the efficiency of household water use, and encourage the sustainable use and conservation of water resources.

The top-level objectives of this study were:

- To investigate household water use behaviour and water appliance characteristics;
- To analyse household behaviours and appliance characteristics to water consumption;
- To estimate household water consumption and pattern;
- To examine the reliability of the research results;
- To compare the results of this research with other Chinese cities;
- To analyse any water-saving potential for the residential sector.

In more detail the research explored the following:

Household water usage behaviour:

- Personal water usage habits, including appliance use frequency and the corresponding average duration e.g. shower use frequency and duration of each shower.

Characteristics of water appliances:

- Water flow rates associated with different appliances e.g. showerheads and taps
- Common types of water use appliance at home
- The percentage of people who owned water efficient appliances e.g. dual flush toilet

Water use patterns:

<ul style="list-style-type: none"> <li>- Analysis of survey results and classification of water use patterns (low/moderate/high consumption)</li> <li>- the impact of the identified patterns</li> </ul> <p>Comparison analysis of water pattern:</p> <ul style="list-style-type: none"> <li>- Identification of any differences in water use patterns between Harbin and other countries or Chinese cities, and the underlying causes of these differences.</li> </ul>	
Descriptive keywords:	'Domestic water consumption'
Project Website:	<a href="http://www.switchurbanwater.eu/outputs/pdfs/W3-1_GEN_PHD_Research_of_domestic_water_consumption_-_a_field_study_in_Harbin_China.pdf">http://www.switchurbanwater.eu/outputs/pdfs/W3-1 GEN PHD Research of domestic water consumption - a field study in Harbin China.pdf</a>
<u>Key Deliverables/Publications and Links</u> <p>Lu, T. (2007). <i>Research of domestic water consumption a field study in Harbin, China</i>. Master of Science. Loughborough University.</p>	

## Action C.2: Eco-label Scheme

### Brief Description of the Concrete Action

The sole beneficiary for this action is EWA who shall be responsible for the overall coordination and implementation of the action.

Action C.2 intends to develop a voluntary water labelling strategy aimed at promoting water efficient devices and appliances so as to empower consumers with verifiable information. This action addresses water demand and is ranked as a top priority in the hierarchy of water management measures published in various communications by the EU Commission. It has been established that 40% of the current demand in Europe can be reduced through water saving and improved efficiency. This is also aligned with the measures in Malta's 2<sup>nd</sup> River Basin Management Plan which also provides for the awareness and education on water conservation, in particular targeting the issue of water scarcity and other challenges.

The proposed water rating label (to be designed similar to the existing Energy label in Malta), entails designated water-using products to have clearly displayed, at the point of sale, a star rating label demonstrating the water efficiency standard and information about the volume of water used. Thus standards for a *Water Efficient Products Label* need to be developed. The water rating label would allow consumers to compare products in order to be able to make the correct choice; thus rewarding manufacturers and retailers who manufacture and stock water efficient models/devices.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.2: Eco-label Scheme
Project Title:	Meso-level eco-efficiency indicators to assess technologies and their uptake in water use sectors
Project Acronym/ID:	EcoWater/ <u>282882</u>

Project Duration: yyyy-yyyy (if project is still ongoing: yyyy-)	01-11-2011 to 31-12-2014
Project Status:	Completed
Funding Programme:	FP7-ENVIRONMENT
Key Contacts:	Contact Person 1: Name: Dionysis Assimacopoulos Email/Telephone: +30 210 7723218 Institution: National Technical University of Athens
<u>Project Summary</u>  <p>EcoWater addressed the development of meso-level eco-efficiency indicators for technology assessment through a systems' approach. The effort focussed on enhancing the understanding of the interrelations of innovative technology uptake in water use systems, and their economic and environmental impacts. Research addressed a selection of indicators appropriate for the assessment of system-wide eco-efficiency improvements, the integration of existing tools and assessment methods in a coherent modelling environment, and the analysis and characterisation of existing structures and policies. The foreseen development of an analytical framework was to support:</p> <ul style="list-style-type: none"> <li>(i) Systemic environmental impact assessments,</li> <li>(ii) Economic assessments,</li> <li>(iii) Analysis of value chains and actor interactions,</li> <li>(iv) Technology implementation and uptake scenarios.</li> </ul> <p>Four Case Studies assessed meso-level eco-efficiency improvements from innovative technologies in water systems for the textile industry, for energy production, for dairy production and the automotive industry. The main outputs included a validated and tested methodological framework that supports the four points mentioned above, an integrated toolbox for systems' eco-efficiency analysis, and policy recommendations for technology uptake and implementation. To ensure wide dissemination and applicability, the project organised activities to address different target audiences and to develop operational science-industry-policy links at the level of Case Studies and at wider EU and international scale.</p>	
Descriptive keywords:	'Eco-efficiency'
Project Website	<a href="http://cordis.europa.eu/project/rcn/100813_en.html">http://cordis.europa.eu/project/rcn/100813_en.html</a> <a href="http://environ.chemeng.ntua.gr/ecowater">http://environ.chemeng.ntua.gr/ecowater</a>
<u>Key Deliverables/Publications and Links</u>  <u>Deliverables:</u>  <p>Deliverable 1.1: Review and selection of eco-efficiency indicators to be used in the EcoWater Case Studies – Report</p> <p>Deliverable 1.2: Technology inventory design and specifications – Report and Technology Inventory</p> <p>Deliverable 1.3: Populated Technology Inventory – Report and Populated Technology Inventory</p> <p>Deliverable 1.4: Review of existing frameworks and tools for developing eco-efficiency indicators - Report</p> <p>Deliverable 1.5: Finalized Systemic Environmental Analysis Tool (SEAT) – Report</p> <p>Deliverable 1.6: Finalized Economic Value chain Analysis Tool (EVAT) – Report</p> <p>Deliverable 2.1: Value Chain Mapping of the Agricultural Water Systems – Report</p>	

Deliverable 2.2: Baseline eco-efficiency assessment for the analysed agricultural water systems - Report
Deliverable 2.3: Innovative Technologies for Eco-Efficiency Improvement in Agricultural Water Use - Report
Deliverable 2.4: Technology assessment and scenario analysis – Report
Deliverable 3.1: Value Chain Description of the Analysed Urban Water Systems - Report
Deliverable 3.2: Baseline eco-efficiency assessment in urban water systems – Report
Deliverable 3.3: Innovative technologies for eco-efficiency improvement - Report
Deliverable 3.4: Technology assessment and scenario analysis - Report
Deliverable 4.1: Description of value chains for industrial water use - Report
Deliverable 4.2: Description of value chains for industrial water use – Report
Deliverable 4.3: Innovative technologies for enhancing the eco-efficiency of water use in industries – Report
Deliverable 4.4: Technology assessment and scenario analysis - Report
Deliverable 5.1: Step-wise consolidated guidelines for the development of meso-scale eco-efficiency indicators - Report
Deliverable 5.2: Cross-comparison of Case-study Outcomes - Report
Deliverable 5.3: Functional design of the meso-scale eco-efficiency toolbox - Report
Deliverable 5.10: Finalized guidelines for the use of the EcoWater Toolbox - Report
Deliverable 5.11: Finalized guidelines for the use of the EcoWater Toolbox - Report
Deliverable 6.1: Synthesis report from the 1st Round of Case Study Events - Report
Deliverable 6.2: Synthesis report from the 2nd Round of Case Study Events – Report
Deliverable 6.3: Proceedings of the 1st targeted event Research links – Report
Deliverable 6.4: Report from the 2nd targeted event (Policy links) - Report
Deliverable 6.5: Report from the 3rd targeted event (Policy links) - Report
Deliverable 6.6: Conference Proceedings
Deliverable 6.7: Project Web Site - Report
Deliverable 6.8: Project Factsheet – Report
<u>Dissemination:</u>
Deliverable 6.10: 1st EcoWater Newsletter
Deliverable 6.11: 2nd EcoWater Newsletter
Deliverable 6.12: 3rd EcoWater Newsletter
Deliverable 6.13: 4th EcoWater Newsletter
Deliverable 6.14: EcoWater Science-Policy Briefs
Deliverable 6.15: Ecowater Product Fliers

Relevant LIFE IP Concrete Action:	Action C.2: Eco-label Scheme
Project Title:	Water efficiency of products and buildings: the implementation of certification and labelling measures in Portugal (Scientific Paper)
Project Acronym/ID:	Not Applicable
Project Duration:	Not Available



Project Status:	Not Applicable
Funding Programme:	Not Applicable
Key Contacts:	<p>Contact Person 1: Name: A. Silva-Afonso Email: silva.afonso@ua.pt Institution: University of Aveiro</p> <p>Contact Person 2: Name: C. Rodrigues Email: anqip@civil.ua.pt Institution: Associação Nacional para a Qualidade nas Instalações Prediais (ANQIP)</p>
<p><u>Project Summary</u></p> <p>This paper outlines some of the actions being pursued in Portugal with a view to improve water efficiency in buildings and products. One such action is the AveiroDOMUS House of the Future which will be used to study various efficiency solutions for resources' use in buildings, and to assess their economic and environmental value.</p> <p>The house has an advanced design and its main objective is to be built in accordance with sustainable building standards, ensuring proper interaction with local ecosystems and a good interior environment (air quality, absence of noise, comfortable temperature and humidity). Moreover, the house also aims to reduce the consumption of essential resources by choosing the appropriate materials, use renewable energy sources and optimize the water cycle.</p> <p>The hydrological cycle was optimized by incorporating sustainability principles such as water recycling and reutilization, the installation of low-flow fixtures and the use of rainwater, groundwater and salt water, the latter being abundant in the area where the house is to be built – the Aveiro Salt Lagoon.</p> <p>The house is used as a permanent research and development laboratory, open to both industry and the public. It is divided in three parts, one part is open to visitors, another part is inhabited and another one is under study. It is projected that the latter will support the study and development of a possible model for the certification of water efficiency of buildings in Portugal.</p> <p>Another initiative is that taken by universities and firms in the sector. This has led to the formation of an association (ANQIP – National Association for Quality in Building Installations) to decide on the implementation of a voluntary water-efficiency certification and labelling system for products.</p>	
Descriptive keywords:	'Water-efficiency' 'water-efficiency labelling' 'products' 'buildings'
Project Website:	Not Applicable
<p>Key Deliverables/Publications and Links:</p> <p>Silva-Afonso, A. and Rodrigues, C. (n.d.). Water efficiency of products and buildings: the implementation of certification and labelling measures in Portugal. [online] Available at: <a href="https://www.irbnet.de/daten/iconda/CIB11855.pdf">https://www.irbnet.de/daten/iconda/CIB11855.pdf</a> [Accessed 29 Jan. 2018].</p>	
Relevant LIFE IP Concrete Action:	Action C.2: Eco-label Scheme

Project Title:	A Mandatory Water Efficiency Labelling Scheme for Australia (Report)
Project Acronym/ID:	Not Applicable
Project Duration:	June, 2003 (Date of Publication)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Not Available Email: geosanna@ozemail.com.au Institution: George Wilkenfeld and Associates Pty Ltd
<u>Project Summary</u>  <p>The purpose of this study, commissioned by Environment Australia, was to examine the potential for, and impacts of, introducing a national mandatory water efficiency labelling (WEL) scheme and minimum water efficiency standards (WES) for appliances, fixtures and fittings as a method of reducing urban water consumption. One example of such a scheme is the National Appliance and Equipment Energy Efficiency Program (NAEEEP) where labelling and water performance requirements are specified in relevant Australian Standards, given effect by regulation and managed by government agencies.</p> <p>The regulatory framework for implementation was outside the scope of this study. However, the study's conclusions are based on the assumption that whatever framework is adopted, it would be no less effective in enforcing minimum product performance standards and mandatory labelling at the point of sale, than is the current State-based framework for energy labelling and standards.</p> <p>The study suggested that mandatory labelling for water efficient products should be applied to shower heads, toilet suites (i.e. cisterns) and washing machines as the potential water savings are high, therefore being the most cost-effective. It was noted that water efficiency labelling was the most cost-effective for shower heads and washing machines. The study also recommends that mandatory labelling will also be introduced for dishwashers as their water consumption is rising, even though the potential water savings are lower.</p>	
Descriptive keywords:	'Domestic water consumption'
Project Website:	<a href="http://www.switchurbanwater.eu/outputs/pdfs/W3-1_GEN_PHD_Research_of_domestic_water_consumption_-_a_field_study_in_Harbin_China.pdf">http://www.switchurbanwater.eu/outputs/pdfs/W3-1 GEN PHD Research of domestic water consumption - a field study in Harbin China.pdf</a>
<u>Key Deliverables/Publications and Links</u>  <p>Lu, T. (2007). <i>Research of domestic water consumption a field study in Harbin, China</i>. Master of Science. Loughborough University.</p>	

Relevant LIFE IP Concrete Action:	Action C.2: Eco-label Scheme
Project Title:	Cost Effectiveness Analysis of WELS the Water Efficiency Labelling and Standards Scheme (Report)
Project Acronym/ID:	Not Applicable

Project Duration:	May, 2008 (Date of Publication)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	<p>Contact Person 1:  Name: Joanne Chong  Email: <a href="mailto:joanne.chong@uts.edu.au">joanne.chong@uts.edu.au</a>  Institution: Institute for Sustainable Futures</p> <p>Contact Person 2:  Name: Damien Giurco  Email: <a href="mailto:Damien.Giurco@uts.edu.au">Damien.Giurco@uts.edu.au</a>  Institution: Institute for Sustainable Futures</p>
<p><u>Project Summary</u></p> <p>The Water Efficiency Labelling and Standards Scheme (WELS), introduced in July 2006, is a key program in the suite of options recently implemented by government agencies and water utilities to address water scarcity. WELS primarily influences water consumption by providing consumers with information about the water efficiency of all washing machines, dishwashers, toilets, urinals, taps and showers sold in Australia – thus enabling consumers to consider water efficiency as a factor in their purchase decisions.</p> <p>However, the WELS program is not without costs. Governments, suppliers, retailers and consumers of WELS-products potentially incur costs due to WELS activities and requirements. The Department of the Environment, Heritage, Water and the Arts, in its capacity as the WELS Regulator, commissioned the Institute of Sustainable Futures to analyse the cost-effectiveness of WELS in contributing to the overarching objective of water security, compared to other urban water management options. Consistent with the regulatory impact statement conducted in 2003, this analysis uses a time horizon of 2005-06 to 2020-21.</p> <p>The study found that WELS was significantly more cost-effective to achieve water security, when compared to the current or planned demand and supply options in Australia. In comparison to other water security options, WELS was found to have a relatively good cost-effectiveness. As a result, it is likely that WELS is part of a package of options to achieve water security in Australian jurisdictions. The study also suggests that at least theoretically, mandatory labelling can enable water users to respond to increases in water prices.</p>	
Descriptive keywords:	'Cost Effective' 'Efficiency Labelling' 'Schemes'
Project Website:	<a href="https://opus.lib.uts.edu.au/bitstream/10453/37615/1/cost-effectiveness-wels.pdf">https://opus.lib.uts.edu.au/bitstream/10453/37615/1/cost-effectiveness-wels.pdf</a>
<p><u>Key Deliverables/Publications and Links</u></p> <p>Chong, J., Kazaglis A. and Giurco D. 2008, Cost effectiveness analysis of WELS – the Water Efficiency Labelling and Standards Scheme. Prepared for the Australian Government Department of the Environment, Water, Heritage and the Arts by the Institute for Sustainable Futures, University of Technology, Sydney.</p>	

Relevant LIFE IP Concrete Action:	Action C.2: Eco-label Scheme
Project Title:	Labelling and water conservation: A European perspective on a global challenge
Project Acronym/ID:	Not Applicable
Project Duration:	2015 (Date of Publication)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: David Kelly Email: <a href="mailto:d.a.kelly@hw.ac.uk">d.a.kelly@hw.ac.uk</a> Institution: <a href="http://www.heriot-watt.ac.uk">Heriot-Watt University</a>
<u>Project Summary</u>  <p>The European Commission has identified labelling as a means of encouraging consumers to opt for water efficient products. A common water label at the European level would help countries achieve water efficiency in a cohesive way. This paper examines some of the water labelling schemes currently implemented in countries around the world in order to draw together a knowledge-base of water labelling best practice. Mandatory labels are shown to be most effective at encouraging consumer uptake, while additional supportive information (such as product performance data and potential financial savings) would help inform consumer purchase decisions. Consideration of national implications, economic impact, regulation and enforcement and establishing impact indicators, are all shown to be vital components of an effective water labelling scheme.</p> <p>Practical application:</p> <p>A Europe-wide water label would help promote the uptake of water-efficient products by providing consumers with information about the water consumption characteristics of products at the point of sale. It is intended that the water labelling best practice presented here is used by policy makers and regulators to help inform future initiatives in introducing a Europe-wide water label. Incorporating lessons from best practice will help ensure that such an initiative will achieve its full water saving potential by encouraging consumer purchasing, and pushing market development, towards highly water-efficient products and, ultimately, reducing household water consumption.</p>	
Descriptive keywords:	'Europe' 'water conservation' 'water efficiency' 'product labelling'
Project Website:	Not Applicable
<u>Key Deliverables/Publications and Links</u>  <p>Kelly, D. (2015). Labelling and water conservation: A European perspective on a global challenge. <i>Building Services Engineering Research and Technology</i>, [online] 36(6), pp.643-657. Available at:  <a href="https://www.researchgate.net/profile/David_Kelly25/publication/276348216_Labelling_and_water_conservation_A_European_perspective_on_a_global_challenge/links/55db2cf908aeb38e8a8b659e.pdf">https://www.researchgate.net/profile/David_Kelly25/publication/276348216_Labelling_and_water_conservation_A_European_perspective_on_a_global_challenge/links/55db2cf908aeb38e8a8b659e.pdf</a> [Accessed 29 Jan. 2018].</p>	

## Action C.3: Remote sensing for agricultural water demand

### Brief Description of the Concrete Action

The sole beneficiary for this action is EWA who shall be responsible for the overall coordination and implementation of the action.

The objective of this action is to create an online tool for the management of water in the agricultural sector. The approach adopted shall be based on the use of optical Earth Observation data, specifically using the Sentinel 2 data of the Copernicus programme, which is freely available for public use on the European Space Agency website.

Malta is covered by the Granule ID 33SVV of the Sentinel-2 of the currently available products and the revisit acquisition of the satellite is 10 days. The low cloud cover percentage over Malta and the high spatial resolution offers a great opportunity for applying earth observation for water management in agriculture.

The development of this online tool shall be carried out through the services of an external consultant whose task shall be to develop an online tool which is capable of downloading, processing and analysing the Sentinel 2 imagery and allow the generation of meaningful information through the application of the Normalised Difference Vegetation Index (NDVI).

The implementation of this measure requires the continued development of the groundwater abstraction metering project.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.3: Remote sensing for agricultural water demand
Project Title:	Environmental Optimization of Irrigation Management with the Combined use and Integration of High Precision Satellite Data, Advanced Modeling, Process Control and Business Innovation
Project Acronym/ID:	ENORASIS/282949
Project Duration:	January 2012- December 2014
Project Status:	Completed
Funding Programme:	FP7-ENVIRONMENT
Key Contacts:	Contact Person 1: Name: Dr. Machi Simeonidou Email: <a href="mailto:msimeonidou@draxis.gr">msimeonidou@draxis.gr</a> Institution: DRAXIS ENVIRONMENTAL S.A., Greece
<u>Project Summary</u>  In light of the real need to practically improve the environmental performance of irrigation systems and to prevent the misuse of water, ENORASIS project developed an intelligent irrigation Decision Support System (ENORASIS Service Platform and Components), which enables sustainable irrigation management for farmers and water management organizations.	

ENORASIS is a server-based system that gathers data from satellite observations and field equipment (wireless sensor networks), that uses the next-generation weather prediction model Weather Research and Forecasting Model (WRF) to provide high spatial accuracy estimations for precipitation. It combines all this information with specific crop characteristics (using FAO56 model) to produce daily optimal irrigation advice that is communicated to farmers via web or mobile. Accordingly, farmers may use this real-time information to schedule irrigation activities also in interaction with other cultivation tasks and monitor water consumption both in terms of quantity and cost. Water Management Authorities may use water consumption monitoring data to estimate short and long term pressures on water reservoirs, set water prices as drivers for sustainable irrigation and apply pricing schemes that incorporate the real costs of water (in accordance with the Water Framework Directive - WFD).

The project has achieved the development of the ENORASIS platform and other components (such as the Meteo Analysis Tool, Wireless Sensor Network - WSN, Digital Signature Standard - DSS algorithm). In addition, interfaces with billing systems and the relative subsystems and functionalities were also developed. Web and mobile ENORASIS users' interfaces and Geographic Information System (GIS) application of ENORASIS were prepared, with a friendly, easy-to-use layout targeted to end-users' needs.

The ENORASIS system has been tested for 2 cultivation periods in 5 pilot implementations covering 9 different crops, 4 different climatic conditions and 2 operational approaches. The performance of pilots was validated and assessed against specific Key Performance Indicators. Four policy workshops, three scientific ones and a final conference have been organised with around 500 participants in total, accomplishing proper dissemination of the project and its results and contributing to policy dialogue about sustainable irrigation management in Europe.

Descriptive keywords (maximum of 5)	'Remote sensing' 'Agriculture'
Project Website (include a link)	<a href="http://cordis.europa.eu/result/rcn/167789_en.html">http://cordis.europa.eu/result/rcn/167789_en.html</a> <a href="http://www.enorasis.eu">www.enorasis.eu</a>

#### Key Deliverables/Publications and Links

##### Dissemination material:

ENORASIS leaflet - [http://www.enorasis.eu/uploads/files/Enorasis\\_leaflet\\_Low.pdf](http://www.enorasis.eu/uploads/files/Enorasis_leaflet_Low.pdf)

ENORASIS Poster 1 - [http://enorasis.eu/uploads/images/Enorasis\\_Posters\\_A3\\_Low1.jpg](http://enorasis.eu/uploads/images/Enorasis_Posters_A3_Low1.jpg)

ENORASIS Poster 2 - [http://enorasis.eu/uploads/images/Enorasis\\_Posters\\_A3\\_Low2.jpg](http://enorasis.eu/uploads/images/Enorasis_Posters_A3_Low2.jpg)

ENORASIS 1st Info Factsheet - [http://www.enorasis.eu/uploads/files/1stfactsheet\\_ENORASIS.pdf](http://www.enorasis.eu/uploads/files/1stfactsheet_ENORASIS.pdf)

ENORASIS 1st Newsletter - [http://www.enorasis.eu/uploads/files/ENORASIS\\_1st\\_newsletter.pdf](http://www.enorasis.eu/uploads/files/ENORASIS_1st_newsletter.pdf)

ENORASIS A1 Poster first presented in STEP-WISE and STREAM Final Conference - [http://www.enorasis.eu/uploads/images/Enorasis\\_Posters\\_A1\\_594x841.jpg](http://www.enorasis.eu/uploads/images/Enorasis_Posters_A1_594x841.jpg)

ENORASIS 2nd Info Factsheet - [http://www.enorasis.eu/uploads/files/2nd\\_ENORASIS\\_factsheet-12-12.pdf](http://www.enorasis.eu/uploads/files/2nd_ENORASIS_factsheet-12-12.pdf)

ENORASIS 3rd Info Factsheet - [http://www.enorasis.eu/uploads/files/EnorasisFactSheet\\_3.pdf](http://www.enorasis.eu/uploads/files/EnorasisFactSheet_3.pdf)

ENORASIS 4th Info Factsheet -

[http://www.enorasis.eu/uploads/files/D7.15\\_Enorasis\\_4th\\_FACTSHEET.pdf](http://www.enorasis.eu/uploads/files/D7.15_Enorasis_4th_FACTSHEET.pdf)

ENORASIS 2nd Newsletter - [http://www.enorasis.eu/uploads/ENORASIS\\_2nd\\_newsletter.pdf](http://www.enorasis.eu/uploads/ENORASIS_2nd_newsletter.pdf)

ENORASIS 3rd Newsletter - [http://www.enorasis.eu/uploads/Enorasis\\_Newsletter\\_11-2013.pdf](http://www.enorasis.eu/uploads/Enorasis_Newsletter_11-2013.pdf)

ENORASIS 4th Newsletter - [http://www.enorasis.eu/uploads/Enorasis\\_Newsletter\\_8-2014.pdf](http://www.enorasis.eu/uploads/Enorasis_Newsletter_8-2014.pdf)

ENORASIS 5th Newsletter - [http://www.enorasis.eu/uploads/Enorasis\\_Newsletter\\_11-2014\\_fin.pdf](http://www.enorasis.eu/uploads/Enorasis_Newsletter_11-2014_fin.pdf)

#### Project Deliverables:

D1.1 SOTA Report - [http://www.enorasis.eu/uploads/files/ENORASIS\\_SOTA\\_report.pdf](http://www.enorasis.eu/uploads/files/ENORASIS_SOTA_report.pdf)

D1.2 Agricultural Process Analysis Report –

[http://www.enorasis.eu/uploads/files/ENORASIS\\_Deliverables\\_1.2\\_v1.3-1.pdf](http://www.enorasis.eu/uploads/files/ENORASIS_Deliverables_1.2_v1.3-1.pdf)

D2.1 Report on Irrigation Water Governance in the context of WFD and CAP -

[http://www.enorasis.eu/uploads/files/D2%20ENORASIS\\_GOVERNANCE\\_AND\\_BUSINESS\\_v12.pdf](http://www.enorasis.eu/uploads/files/D2%20ENORASIS_GOVERNANCE_AND_BUSINESS_v12.pdf)

D2.2 ENORASIS Business Models -

[http://www.enorasis.eu/uploads/files/ENORASIS\\_Deliverable\\_2.2\\_v1.pdf](http://www.enorasis.eu/uploads/files/ENORASIS_Deliverable_2.2_v1.pdf)

D2.3 ENORASIS Platform Use Case Scenarios and User Requirements -

<http://www.enorasis.eu/uploads/files/D2.3%20ENORASIS%20PLATFORM%20USE%20CASESv1.0.pdf>

D5.2 ENORASIS User Manual -

[http://www.enorasis.eu/uploads/files/ENORASIS\\_Deliverable\\_5.2.pdf](http://www.enorasis.eu/uploads/files/ENORASIS_Deliverable_5.2.pdf)

D5.3 ENORASIS Technical Documentation -

[http://www.enorasis.eu/uploads/files/ENORASIS\\_Deliverable\\_5.3.pdf](http://www.enorasis.eu/uploads/files/ENORASIS_Deliverable_5.3.pdf)

D6.1 Pilot Implementation Guidelines -

[http://www.enorasis.eu/uploads/files/ENORASIS\\_Deliverables\\_6.1.pdf](http://www.enorasis.eu/uploads/files/ENORASIS_Deliverables_6.1.pdf)

D6.2 Pilots' Interim Report - [http://www.enorasis.eu/uploads/files/ENORASIS\\_6.2.pdf](http://www.enorasis.eu/uploads/files/ENORASIS_6.2.pdf)

D6.3 Pilots' Final Report - [http://www.enorasis.eu/uploads/ENORASIS\\_Deliverables\\_6.3.pdf](http://www.enorasis.eu/uploads/ENORASIS_Deliverables_6.3.pdf)

D6.4 Pilots Assessment Report - [http://www.enorasis.eu/uploads/ENORASIS\\_Del\\_6.4.pdf](http://www.enorasis.eu/uploads/ENORASIS_Del_6.4.pdf)

D7.4 Report on ENORASIS Events (scientific/ policy workshops) -

[http://www.enorasis.eu/uploads/files/D7.4\\_Events.pdf](http://www.enorasis.eu/uploads/files/D7.4_Events.pdf)

D7.5 Report on ENORASIS Events (final conference) -

[http://www.enorasis.eu/uploads/files/D.7.5\\_ENORASIS\\_Events\\_Final.pdf](http://www.enorasis.eu/uploads/files/D.7.5_ENORASIS_Events_Final.pdf)

D7.14 Policy Recommendations for Decision Makers and Water Management Organisations (Policy brief) - [http://www.enorasis.eu/uploads/files/D7.14\\_Policy\\_brief\\_sust\\_irr.pdf](http://www.enorasis.eu/uploads/files/D7.14_Policy_brief_sust_irr.pdf)

Relevant LIFE IP Concrete Action:	Action C.3: Remote sensing for agricultural water demand
Project Title:	<a href="#">Spatial earth observation monitoring for planning and water allocation in the international Incomati Basin</a>
Project Acronym/ID:	WATPLAN/262949
Project Duration:	01/02/2011 – 31/08/2013
Project Status:	Completed
Funding Programme:	<a href="#">FP7-SPACE</a>
Key Contacts:	Contact Person 1: Name: Prof.Dr. W.G.M. Bastiaanssen Email: <a href="mailto:w.bastiaanssen@waterwatch.nl">w.bastiaanssen@waterwatch.nl</a> Institution: WaterWatch B.V., Netherlands
<p><u>Project Summary</u></p> <p>Equitable and efficient water management and allocation, especially across country borders, needs accurate information on the use and availability of water resources in space and time. An operational monitoring system that covered the Incomati River Basin helped in fulfilling the need for transparency by providing quantified information on water use.</p> <p>The “Spatial Earth Observation Monitoring for Planning and Water Allocation in the International Incomati Basin project” - or WatPLAN – set up such an operational monitoring system. This joint European Union-Africa GMES earth observation project combines earth observation and <i>in situ</i> data to provide near-real time quantified information at field scale on (agricultural) water need and consumption.</p> <p>The joint efforts of a consortium of international Small and Medium Enterprises (SMEs) and universities have resulted in a unique operational monitoring system that is capable of providing weekly quantified information at field scale by using the Surface Energy Balance Algorithm for Land (SEBAL) model. This model has been applied and evaluated in more than 30 countries including many African countries. The energy balance describes how solar energy is distributed; part is reflected or absorbed by the surface, and part is used for plant growth. These components of the energy balance can be derived from satellite data using the model to quantify an important component of the water cycle - Evapotranspiration (ET). Subsequently, biomass production, actual, and potential water consumption, and water deficit are derived on a pixel-by-pixel basis.</p> <p>Rainfall is another important parameter within the project and is derived by combining microwave data from the FEWS-NET sensor with <i>in situ</i> rainfall data measured using low cost meteorology stations installed as part of the project. These data products provide valuable insight in various aspects of the water balance important for water management. Such aspects include the distribution of renewable water resources, crop yield and water productivity.</p> <p>For instance, these data products can be used by technical committees and agencies, irrigation boards and farmers and also for water accounting. Water accounting contributes to better water allocation, verification of water use and sustainable utilisation of scarce water resources.</p>	



Descriptive keywords (maximum of 5)	'Earth Observation'
Project Website (include a link)	<a href="http://cordis.europa.eu/result/rcn/144038_en.html">http://cordis.europa.eu/result/rcn/144038_en.html</a> <a href="http://www.watplan.eu">www.watplan.eu</a> <a href="http://www.watplan.com">www.watplan.com</a>
Key Deliverables/Publications and Links:	
Final Report - <a href="http://cordis.europa.eu/docs/results/262949/final1-watplan-final-report.pdf">http://cordis.europa.eu/docs/results/262949/final1-watplan-final-report.pdf</a>	

Relevant LIFE IP Concrete Action:	Action C.3: Remote sensing for agricultural water demand
Project Title:	Global Earth Observation for integrated water resource assessment
Project Acronym/ID:	EARTH2OBSERVE/603608
Project Duration:	01-01-2014 to 31-12-2017
Project Status:	Completed
Funding Programme:	<a href="#">FP7-ENVIRONMENT</a>
Key Contacts:	Contact Person 1: Name: Jaap Schellekens Email: <a href="mailto:Jaap.Schellekens@deltares.nl">Jaap.Schellekens@deltares.nl</a> Institution: STICHTING DELTARES

#### Project Summary

The project earth2Observe brings together the findings from European Framework Programme (FP) projects DEWFORA, GLOWASIS, WATCH, GEOWOW and others. It has integrated available global earth observations (EO), *in situ* datasets and models and constructed a global water resources re-analysis dataset of significant length (several decades). The resulting data enabled improved insights on the full extent of available water and existing pressures on global water resources in all parts of the water cycle.

The project supported efficient and globally consistent water management and decision making by providing comprehensive multi-scale (regional, continental and global) water resources observations. It has also tested new EO data sources, extended existing processing algorithms and combined data from multiple satellite missions in order to improve the overall resolution and reliability of EO data included in the re-analysis dataset. The usability and operational value of the developed data was verified and demonstrated in a number of case-studies across the world, which aimed to improve the efficiency of regional water distribution. The case-studies were conducted together with local end-users and stakeholders. Regions of interest cover multiple continents, a variety of hydrological, climatological and governance conditions and differ in the degree of data richness (e.g. the Mediterranean and Baltic region, Ethiopia, Colombia, Australia, New Zealand and Bangladesh).

The data was disseminated through an open data Water Cycle Integrator portal to ensure an increased availability of global water resources information on both regional and global scale. The data portal was the European contributor to the existing GEOSS water cycle platforms and communities. Project results were actively disseminated using a combination of traditional

methods (workshops, papers, website and conferences) and novel methods such as E-learning courses and webinars that promote the use of the developed dataset.

Descriptive keywords:

'Earth Observation' Water'

Project Website:

[http://cordis.europa.eu/project/rcn/111322\\_en.html](http://cordis.europa.eu/project/rcn/111322_en.html)  
[www.earth2observe.eu](http://www.earth2observe.eu)

Key Deliverables/Publications and Links:

Periodic Report Summaries:

Periodic Summary Report 1 - [http://cordis.europa.eu/result/rcn/176873\\_en.html](http://cordis.europa.eu/result/rcn/176873_en.html)

Periodic Summary Report 2 – [http://cordis.europa.eu/result/rcn/201682\\_en.html](http://cordis.europa.eu/result/rcn/201682_en.html)

Dissemination material:

Leaflet number 1 - [http://cordis.europa.eu/docs/results/603/603608/periodic1-e2o\\_leaflet-no1\\_en\\_web.pdf](http://cordis.europa.eu/docs/results/603/603608/periodic1-e2o_leaflet-no1_en_web.pdf)

Newsletter issue 1 - [http://www.earth2observe.eu/files/newsletters/E2O\\_Newsletter%20No1.pdf](http://www.earth2observe.eu/files/newsletters/E2O_Newsletter%20No1.pdf)

Newsletter issue 2 - [http://www.earth2observe.eu/files/newsletters/E2O\\_Newsletter%20No2.pdf](http://www.earth2observe.eu/files/newsletters/E2O_Newsletter%20No2.pdf)

Publications:

A global water resources ensemble of hydrological models: the earthH2Observe Tier-1 dataset - <https://www.earth-syst-sci-data.net/9/389/2017/essd-9-389-2017.pdf>

The residence time of water in the atmosphere revisited - <https://www.hydrol-earth-syst-sci.net/21/779/2017/hess-21-779-2017.pdf>

Validation of a new SAFRAN-based gridded precipitation product for Spain and comparisons to Spain02 and ERA-Interim - <https://www.hydrol-earth-syst-sci.net/21/2187/2017/hess-21-2187-2017.pdf>

Public Deliverables:

D2.2 – Review Report on European Policies -

[http://earth2observe.eu/files/Public%20Deliverables/D2-2\\_Review\\_report\\_final.pdf](http://earth2observe.eu/files/Public%20Deliverables/D2-2_Review_report_final.pdf)

D2.3 – Review Report on stakeholders and relevant policies in non-European case study river basins - [http://earth2observe.eu/files/Public%20Deliverables/D2.3-Review\\_Stakeholders\\_Policies\\_v2.pdf](http://earth2observe.eu/files/Public%20Deliverables/D2.3-Review_Stakeholders_Policies_v2.pdf)

D2.4 – Gap analysis of data requirements in support of European policies -

[http://earth2observe.eu/files/Public%20Deliverables/D.2.4-Gap\\_Analysis\\_EU\\_Policies\\_v1.0-1.pdf](http://earth2observe.eu/files/Public%20Deliverables/D.2.4-Gap_Analysis_EU_Policies_v1.0-1.pdf)

D2.5 – Gap analysis of input data requirements in support of decision making of water allocation in (transboundary) basins - [http://earth2observe.eu/files/Public%20Deliverables/D2.5-Gap\\_analysis\\_input\\_data\\_requirements\\_v4.pdf](http://earth2observe.eu/files/Public%20Deliverables/D2.5-Gap_analysis_input_data_requirements_v4.pdf)

D2.6 – Report on global scale assessment of physical and social water scarcity -  
[http://earth2observe.eu/files/Public%20Deliverables/D2.6\\_Report\\_global%20assessment%20of%20water%20scarcity.pdf](http://earth2observe.eu/files/Public%20Deliverables/D2.6_Report_global%20assessment%20of%20water%20scarcity.pdf)

D3.1 – Inventory of Earth Observation datasets -  
[http://earth2observe.eu/files/Public%20Deliverables/E2O\\_D3.1\\_Data\\_Inventory\\_v03.pdf](http://earth2observe.eu/files/Public%20Deliverables/E2O_D3.1_Data_Inventory_v03.pdf)

D3.2 – Draft Report on EO Datasets -  
[http://earth2observe.eu/files/Public%20Deliverables/D3.2\\_Draft\\_Report\\_on\\_EO\\_Datasets.pdf](http://earth2observe.eu/files/Public%20Deliverables/D3.2_Draft_Report_on_EO_Datasets.pdf)

D3.3 – Release 1 of EO datasets -  
[http://earth2observe.eu/files/Public%20Deliverables/D3.3\\_Release\\_1\\_EO\\_Datasets\\_v03.pdf](http://earth2observe.eu/files/Public%20Deliverables/D3.3_Release_1_EO_Datasets_v03.pdf)

D3.4 – Report of the Joint Workshop on WPs 3-4-5-6 -  
[http://earth2observe.eu/files/Public%20Deliverables/D3.4\\_Report\\_of\\_the\\_Joint\\_Workshop\\_on\\_WPs\\_3-4-5-6.pdf](http://earth2observe.eu/files/Public%20Deliverables/D3.4_Report_of_the_Joint_Workshop_on_WPs_3-4-5-6.pdf)

D3.6 – Release 2 of EO Datasets -  
[http://earth2observe.eu/files/Public%20Deliverables/D3.6\\_Release\\_2\\_of\\_EO\\_Datasets.pdf](http://earth2observe.eu/files/Public%20Deliverables/D3.6_Release_2_of_EO_Datasets.pdf)

D4.1 – Documentation on the baseline performance of the v1 E2O data -  
[http://earth2observe.eu/files/Public%20Deliverables/D4.1\\_Documentation\\_on\\_the\\_baseline\\_performance\\_of\\_the\\_v1\\_E2O\\_data.pdf](http://earth2observe.eu/files/Public%20Deliverables/D4.1_Documentation_on_the_baseline_performance_of_the_v1_E2O_data.pdf)

D4.2 – Report on precipitation error modeling and ensemble error propagation using LSM and GHM models -  
[http://earth2observe.eu/files/Public%20Deliverables/D4.2\\_Report\\_on\\_precipitation\\_error\\_modeling\\_and\\_ensemble\\_error\\_propagation\\_using\\_LSM\\_and\\_GHM\\_models.pdf](http://earth2observe.eu/files/Public%20Deliverables/D4.2_Report_on_precipitation_error_modeling_and_ensemble_error_propagation_using_LSM_and_GHM_models.pdf)

D5.1 – Report on the current state-of-the-art Water Resources Reanalysis (WRR1-tier 1) -  
[http://earth2observe.eu/files/Public%20Deliverables/D5.1\\_Report%20on%20the%20WRR1%20tier1.pdf](http://earth2observe.eu/files/Public%20Deliverables/D5.1_Report%20on%20the%20WRR1%20tier1.pdf)

D8.7 – Policy Brief No. 1 -  
<http://earth2observe.eu/files/Public%20Deliverables/Policy%20Brief%20No1.pdf>

Relevant LIFE IP Concrete Action:	Action C.3: Remote sensing for agricultural water demand
Project Title:	Implementation of Multi-scale Agricultural Indicators Exploiting Sentinels
Project Acronym/ID:	IMAGINES/311766
Project Duration:	21/02/2013 – 30/06/2016
Project Status:	Completed
Funding Programme:	<a href="#">FP7-SPACE</a>
Key Contacts:	Contact Person 1: Name: Dr. Roselyne Lacaze

	Email: <a href="mailto:rl@hygeos.com">rl@hygeos.com</a> Institution: HYGEOS, France
<p><u>Project Summary</u></p> <p>The innovative IMAGINES project has developed activities to support the operations of the Copernicus Global Land Service (CGLS), and prepared the use of the Sentinels missions' data in an operational context.</p> <p>The main objectives of IMAGINES were to:</p> <ul style="list-style-type: none"> <li>(i) improve the retrieval of basic biophysical variables (Terrestrial Essential Climate Variables), mainly Leaf Area Index (LAI), Fraction of Absorbed Photosynthetically Active Radiation (FAPAR) and surface albedo, by merging the information coming from different sensors (PROBA-V and Landsat-8) in view to prepare the use of Sentinel missions' data;</li> <li>(ii) develop qualified software able to process multi-sensor data at the global scale on a fully automatic basis;</li> <li>(iii) complement and contribute to existing or future agricultural services by providing new data streams relying upon an original method to assess the above-ground biomass, based on the assimilation of satellite products in a Land Data Assimilation System (LDAS) in order to monitor the crop/fodder biomass production together with the carbon and water fluxes;</li> <li>(iv) demonstrate the added value of this contribution for a community of users acting at global, European, national, and regional scales.</li> </ul> <p>Moreover, IMAGINES has favoured the emergence of new downstream activities dedicated to the monitoring of crop and fodder production that are key for the implementation of the EU Common Agricultural Policy, the food security policy, and could contribute to the Global Agricultural Geo-Monitoring Initiative (GEOGLAM) coordinated by the intergovernmental Group on Earth Observations (GEO).</p>	
Descriptive keywords (maximum of 5)	'Remote sensing' 'Agriculture'
Project Website (include a link)	<a href="http://cordis.europa.eu/result/rcn/193421_en.html">http://cordis.europa.eu/result/rcn/193421_en.html</a> <a href="http://www.fp7-imagines.eu/">http://www.fp7-imagines.eu/</a>
<p>Key Deliverables/Publications and Links:</p> <p>IMAGINES has delivered the following deliverables:</p> <ul style="list-style-type: none"> <li>(i) operational processing lines interoperable with the existing CGLS infrastructure and able to run automatically at the global scale to generate global biophysical products disseminated by the CGLS</li> <li>(ii) regional high resolution biophysical variables derived from multi-sensor satellite data</li> <li>(iii) agricultural indicators, including the above-ground biomass, carbon and water fluxes, and drought indices resulting in the assimilation of the biophysical variables in the LDAS</li> <li>(iv) maps of crop group and crop types updated along the season</li> <li>(v) <i>in situ</i> measurements collected during 64 field campaigns over 23 different sites from 2013 to June 2016, resulting in 40 high resolution ground-based maps of LAI, FAPAR and FCover (<a href="http://www.fp7-imagines.eu/pages/services-and-products/ground-data.php">http://www.fp7-imagines.eu/pages/services-and-products/ground-data.php</a>) used, in the CGLS, for the validation of moderate resolution biophysical products.</li> </ul> <p>Results in brief: <i>Better satellite technology helps read the ground more effectively</i> - <a href="http://cordis.europa.eu/result/rcn/198785_en.html">http://cordis.europa.eu/result/rcn/198785_en.html</a></p>	

Relevant LIFE IP Concrete Action:	Action C.3: Remote sensing for agricultural water demand
Project Title:	Root zone soil moisture Estimates at the daily and agricultural parcel scales for Crop irrigation management and water use impact – a multi-sensor remote sensing approach
Project Acronym/ID:	REC/645642
Project Duration:	01-03-2015 to 28-02-2019,
Project Status:	Ongoing
Funding Programme:	H2020-EU.1.3.3. - Stimulating innovation by means of cross-fertilisation of knowledge
Key Contacts:	Contact Person 1: Name: Not available Email: + 34 93 350 55 08 Institution: isardSAT Barcelona
<p><u>Project Summary</u></p> <p>The lack of sustainable water use is a growing concern in Europe. Nowadays, the agricultural sector imposes a high pressure on water resources, especially in Mediterranean countries, where irrigation can represent up to 80% of the consumptive uses of water. Increasing water use efficiency in agriculture has been thus identified as one of the key themes relating to water scarcity and drought. It now becomes necessary to improve on-farm irrigation management by adjusting irrigation to crop water requirements along the growing season.</p> <p>Modern irrigation agencies rely on <i>in situ</i> root zone soil moisture measurements to detect the onset of crop water stress and to trigger irrigations. However, <i>in situ</i> point measurements are generally not available over extended areas and may not be representative at the field scale. Remote sensing can potentially provide cost-effective techniques for monitoring broad areas as there are currently no algorithms dedicated to monitor root zone soil moisture at the parcel scale.</p> <p>REC proposes a solution to the need of root-zone soil moisture at the crop scale for irrigation management. It is based on an innovative operational algorithm that will allow for the first time to:</p> <ol style="list-style-type: none"> <li>1) Map root zone soil moisture on a daily basis at the field scale; and</li> <li>2) Quantitatively evaluate the different components of the water budget at the field scale from readily available remote sensing data.</li> </ol> <p>The methodology relies on the coupling between a surface model representing the water fluxes at the land surface atmosphere interface (infiltration, evaporation, transpiration) and in soil (drainage); and remote sensing data composed of land surface temperature, and near-surface soil moisture retrieved from microwave radiometers and radars.</p> <p>These estimates will be integrated in an irrigation management system that will be used to trigger irrigation. In addition, these estimates will allow making an impact assessment of the consumptive use of water and water footprint.</p>	
Descriptive keywords:	'Agriculture' 'Remote Sensing'

Project Website:	<a href="http://cordis.europa.eu/project/rcn/194344_en.html">http://cordis.europa.eu/project/rcn/194344_en.html</a> <a href="http://rec.isardsat.com/">http://rec.isardsat.com/</a>
Key Deliverables/Publications and Links:	
Periodic Reporting for period 1 - REC (Root zone soil moisture Estimates at the daily and agricultural parcel scales for Crop irrigation management and water use impact – a multi-sensor remote sensing approach) - <a href="http://cordis.europa.eu/result/rcn/203540_en.html">http://cordis.europa.eu/result/rcn/203540_en.html</a>	

## Action C.4: Water Educational Campaign

### Brief Description of the Concrete Action

The lead beneficiary of this action is EWA and shall be responsible for the overall implementation and coordination of this action. The Ministry for Gozo shall be assisting EWA in the implementation of this action in schools located in Gozo.

This action intends to develop and implement a water educational programme targeted specifically at the younger generations of the Maltese Islands, in particular school children. The objective of the programme, shall be to raise awareness on the scarcity of natural water resources in the Maltese Islands and also promote water conservation to the younger generations.

The water educational programme shall consist of a number of components which include:

- 1) The development of a Pedagogic Educational Programme setting out the standards for educational material being used during the implementation of this action.
- 2) The branding, design and printing of water conservation educational material to be used in schools and the community outreach programmes administered by the schools themselves.
- 3) The provision of training through a number of targeted workshops to staff/educators within schools on the significant water management issues faced by the Maltese Islands.
- 4) The organisation of specific awareness raising events, such as the annual activities in commemoration of the Water Day initiative (every 21<sup>st</sup> March).
- 5) The implementation of water conservation projects in schools. Schools in Malta and Gozo shall be given the opportunity to annually come up with proposals on how to develop projects aimed at improving water efficiency within the school. A project review board, formed from personnel currently employed with EWA and MGoZ, shall assess the submissions received and rank the projects based on their water saving potential, replicability and student involvement.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.4: Water Educational Campaign
Project Title:	Enhancement of Public Awareness of the Importance of Water for Life, its Protection and Sustainable Use in Accordance with the Water Framework Directive
Project Acronym/ID:	WATLIFE/ LIFE08 INF/SK/000243
Project Duration:	Data Not Available
Project Status:	Data Not Available
Funding Programme:	LIFE
Key Contacts:	Contact Person 1:

Name: Stefan REHAK Email: <a href="mailto:rehak@vuvh.sk">rehak@vuvh.sk</a> Institution: Not Available	
<p><u>Project Summary</u></p> <p>Slovakia has sufficient water resources for all kinds of uses. However, these water resources are not evenly distributed and in recent years problems of supply (both drinking water and water for commercial use) have arisen in some parts of Slovakia due to inefficient water use. In particular, freshwater, especially drinking water is often wasted.</p> <p>Efficient water management must take into account floods and droughts, the role of water in the biosphere, human impacts on water quantity and quality, prevention of pollution and protection of water resources and water systems – water works, water for agriculture, water for inhabitants and industry, wastewater treatment and the discharge of water. Last but not least, climate change might also be having an impact. Even though areas with temporary shortage of water are found only in certain parts of Slovakia, actions to address the prevention of water shortage should be carried out throughout the country.</p> <p>The main objective of the WATLIFE project was to change common attitudes and inefficient water use practices that are causing shortages and pollution in Slovakia. This change would be achieved through increased awareness of the importance of water and its sustainable use among the general public and among stakeholders, in compliance with the Water Framework Directive. The project would operate alongside communication campaigns undertaken by the Commission and the Slovak government.</p>	
Descriptive keywords:	‘Environmental awareness’ ‘Public awareness’ ‘Campaign’ ‘Consumption pattern’ ‘Water resources management’ ‘Preventive measure’
Project Website:	Not Available
Key Deliverables/Publications and Links:	
<a href="http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&amp;nproj_id=3503&amp;docType=pdf">http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&amp;nproj_id=3503&amp;docType=pdf</a>	

Relevant LIFE IP Concrete Action:	Action C.4: Water Educational Campaign
Project Title:	The Evaluation of Information Campaigns to Promote Voluntary Household Water Conservation (Scientific Article)
Project Acronym/ID:	Not Applicable
Project Duration:	2000 (Date of Publication)
Project Status:	Not Applicable

Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Geoffrey J. Syme Email: Not Available Institution: Edith Cowan University
<u>Project Summary</u>  <p>In this article, several studies which were commissioned to assess the effectiveness of campaigns after their implementation are discussed. In order to be more effective, the article also discusses the role of construction and planning of water conservation campaigns. The role of ongoing evaluation when developing public information programs as demand management tools is also pointed out.</p> <p>For the purposes of this article, public information campaign evaluations are defined as having an identifiable component of information or persuasion. Other policy evaluations pertaining solely to legislation for water-efficient appliances or introduction of pricing policies have been omitted, although technology and price included in water conservation “packages” have been discussed as appropriate. It is acknowledged, however, that the implementation of any new demand strategy imparts new information to the consumer as a matter of course.</p>	
Descriptive keywords:	‘Information campaigns’ ‘Voluntary water conservation’
Project Website:	Not Applicable
Key Deliverables/Publications and Links:  <p>Syme, G., Nancarrow, B. and Seligman, C. (2000). The Evaluation of Information Campaigns to Promote Voluntary Household Water Conservation. <i>Evaluation Review</i>, 24(6), pp.539-578.</p>	

Relevant LIFE IP Concrete Action:	Action C.4: Water Education Campaign
Project Title:	The impact and potential of water education in early childhood care and education settings : a report of the Rous Water Early Childhood Water Aware Centre Program (Report)
Project Acronym/ID:	Not Applicable
Project Duration:	October, 2008 (Date of Publication)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Authors:  Dr Julie Davis Melinda Miller Wendy Boyd Megan Gibson
Project Summary:	



Water consumption and water conservation are significant issues in Australia. In contrast with many schools across Australia that are already engaged in water education and water conservation programs, the early childhood education sector has been slow to respond to this challenge.

The study comprised two parts; the first part was a statistical analysis to investigate reductions in water usage in the seventeen centres engaged in the program and the second was a qualitative analysis exploring the 'quadruple bottom line' benefits (social, environmental, educational and economic) that stemmed from engagement in Rous Water's Water Aware Centre Program.

Statistical analysis results were inconclusive. From the data available it was not possible to show measurable reductions in water consumption across all centres, as there were too many variables that prevented a valid calculation of reductions. The qualitative findings were compelling in determining the impact of the program, which provide the primary focus for this report.

The qualitative results showed important 'quadruple bottom line' benefits that arose from participation in the program. These included but were not limited to:

- Child leadership and advocacy for water conservation (social benefits);
- Uptake by teaching staff of sustainability education pedagogies (educational benefits);
- Improved water conservation and other resource management practices (environmental benefits);
- More efficient use of water resources (economic benefits).

Correlations between awareness and action, and action and consequence were noteworthy in these results, with positive changes to practices, intentions and ideals at centre level transferring to home and community contexts. Numerous centres made physical changes to their water infrastructure such as large scale redevelopments of centre grounds, while others made substantive efforts to purchase and install water-saving devices. One surprising element of the results was the extent to which children influenced the adults around them in relation to water conservation practices. Both teachers and parents were compelled to make changes to their own water use habits because of the children's advocacy for water-conserving alternatives, a direct consequence of what they had learned in the Water Aware Centre Program.

The results reveal that even a relatively small-scale sustainability education program can provide considerable social, environmental, educational and economic benefits. To date, the early childhood education sector has been an 'untapped' resource in addressing sustainability issues of water use and water conservation. This study demonstrates clearly the potential of sustainability education investments in early years' education.

Descriptive keywords:	'Water education' 'Early Childhood' 'Awareness'
Project Website:	Not Applicable
Key Deliverables/Publications and Links:	
ROUS Water (2008). <i>The Impact and Potential of Water Education in Early Childhood Care and Education Settings</i> .	

## Action C.5: Water App / Water Game

### Brief Description of the Concrete Action

The Lead Beneficiary for this action is the Information Management Unit (IMU) within the Ministry for Energy and Water Management who shall be responsible for the overall coordination and implementation of the action.

The main objective of this action is to focus on consumer trends and guide them towards doing minor behavioural changes that contribute to their households becoming more efficient with their water usage. The action thus seeks to educate consumers on ways to improve water use and cost through a medium (smartphone/tablet) which is widely used by consumers throughout the day. Such applications should indirectly make users more aware of their water consumption.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	ACTION C.5: Water App / Water Game
Project Title:	Ecological Lifestyles for CO2 Reduction
Project Acronym/ID:	EcoLife (LIFE12 INF/IT/000465)
Project Duration:	01-OCT-2013 to 30-SEP -2016
Project Status:	completed
Funding Programme:	LIFE
Key Contacts:	Contact Person 1: Name: Francesco Ruscito Email: <a href="mailto:f.ruscito@legambiente.it">f.ruscito@legambiente.it</a> Institution: LEGAMBIENTE ONLUS
<u>Project Summary</u>  <p>EcoLife (LIFE12 INF/IT/000465) The EcoLife project achieved its objectives to transfer the knowledge and experience gained in professional communication on risk perception and prevention to communication on climate change. It involved non-typical target groups (young couples, domestic workers and pensioners), by proposing concrete climate change mitigation and adaptation actions to adopt in everyday life.</p> <p>Hence, one of the project deliverables was specifically to design, develop and disseminate a project website, an application as iOS and Android and, a simulation game to support the project of raising awareness, dissemination and involvement of the target audience.</p>	
Descriptive keywords:	<ol style="list-style-type: none"> <li>1. environmentally responsible behaviour</li> <li>2. public awareness campaign</li> <li>3. consumption pattern</li> <li>4. emission reduction</li> <li>5. greenhouse gas</li> </ol>

Project Website (include a link)	<a href="http://www.ecolifestyles.eu/en/ecolife-project">http://www.ecolifestyles.eu/en/ecolife-project</a>
 Adobe Acrobat PDFXML Document <u>Key Deliverables/Publications and Links</u>	

Relevant LIFE IP Concrete Action:	C.5: Water App / Water Game
Project Title:	ECOTIC LIFE+ Caravan - Raising awareness of the importance of environmentally sound management of WEEE among identified target groups - Romania
Project Acronym/ID:	LIFE13 INF/RO/000090
Project Duration:	2014-2016
Project Status:	Completed
Funding Programme:	LIFE
Key Contacts:	Contact Person 1: Name: Ema CUMPATA Email: <a href="mailto:ema.cumpata@ecotic.ro">ema.cumpata@ecotic.ro</a> Institution: ASOCIATIA ECOTIC

#### Project Summary

The ECOTIC LIFE+ Caravan project was very successful. It had a direct impact in raising awareness about WEEE in Romania, which has indirectly led to higher collection rates in the country. In turn, this means that less hazardous materials pollute the environment and more material is recovered/recycled.

At the heart of the project's information campaign was the 'ECOTIC Caravan' a vehicle bought second-hand, and adapted to serve as a mobile showroom (with the capacity of an average school class-room). This mobile exhibition – a novelty in Romania – was fitted out to showcase 10 examples of dismantled, typical electronic devices, such as a washing-machine and mobile phone. The interior provided information and helped raise awareness on environmental hazards associated with WEEE and on recycling and reuse possibilities. Tablets were also available for visitors (usually schoolchildren) to play a special 'WEEE game' developed during the project.

Descriptive keywords:	<ol style="list-style-type: none"> <li>1. public awareness campaign</li> <li>2. waste collection</li> <li>3. electrical industry</li> <li>4. electronic material</li> </ol>
Project Website:	<a href="http://www.caravanaecotic.ro/">http://www.caravanaecotic.ro/</a>

#### Key Deliverables/Publications and Links

  
 Adobe Acrobat  
 PDFXML Document

## Action C.6: Demonstration Site for the application of New Water Resources - Gozo

### Brief Description of the Concrete Action

The Lead Beneficiary of this action is the Ministry for Gozo (MGoz) who will be responsible for the overall coordination and implementation of the action. The action also sees the participation as a beneficiary of the Water Services Corporation (WSC) who will provide technical support to MGoz.

This action proposes the development of a demonstration site at the Government Experimental Farm in Gozo for the application of New Water to agricultural irrigation. The demonstration will serve a number of purposes useful to the agricultural sector, namely:

- It will enable a comparative evaluation of crop productivity when using different irrigation sources, one of which being New Water;
- It will demonstrate smart and innovative techniques applicable to irrigation efficiency;
- It will show how groundwater can be substituted feasibly and safely with this new source for irrigation, thus reducing pressure on groundwater bodies;
- It will allay fears and apprehensions on the use of New Water;
- It will provide a good training forum for young farmers to put innovation to practice.

Overall, the proposal will seek to raise awareness on tackling the public perception on New Water and will provide a showcase with tangible examples on the correct and safe application of New Water by different users. As such, the action integrates with the implementation of Malta's 2<sup>nd</sup> River Basin Management Plan and will dovetail with the programme of measures to achieve the qualitative and quantitative milestones earmarked for the 2<sup>nd</sup> and 3<sup>rd</sup> RBMP.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.6 – Demonstration Site for the application of New Water Resources - Gozo
Project Title:	Recovery and Recycling of nutrients TURNing wastewater into added-value products for a circular economy in agriculture
Project Acronym/ID:	Water2Return/730398
Project Duration:	2017 - present
Project Status:	Ongoing
Funding Programme:	H2020 IA – Innovative Action
Key Contacts:	Coordinating Organisation: BIOAZUL S.L. CALLE SEVERO OCHOA 7 29590 CAMPANILLAS Spain Email: <a href="mailto:info@water2return.eu">info@water2return.eu</a> Phone: +34 951047290

Project Summary

Water2REturn proposes a full-scale demonstration process for integrated nutrients recovery from wastewater from the slaughterhouse industry using biochemical and physical technologies and a positive balance in energy footprint. The project will not only produce a nitrates and phosphate concentrate available for use as organic fertiliser in agriculture, but its novelty rests on the use of an innovative fermentative process designed for sludge valorisation which results in a hydrolysed sludge (with a multiplied Biomethane Potential) and biostimulants products, with low development costs and high added value in plant nutrition and agriculture.

This process is complemented by proven technologies such as biological aeration systems, membrane technologies, anaerobic processes for bio-methane production and algal technologies, all combined in a zero-waste-emission and an integrated monitoring control tool that will improve the quality of data on nutrient flows. The project will close the loop by demonstrating the benefits associated with nutrients recycling through the implementation of different business models for each final product. This will be done with a systemic and replicable approach that considers economic, governance and social acceptance aspects through the whole chain of water and targets essentially two market demands: 1) Demand for more efficient and sustainable production methods in the meat industry; and 2) Demand for new recycled products as a nutrient source for agriculture.

As a summary, Water2REturn project adopts a Circular Economy approach where nutrients present in wastewaters from the meat industry can be recycled and injected back into the agricultural system as new raw materials. The project foster synergies between the food and sustainable agriculture industries and propose innovative business models for the resulting products that will open new market opportunities for the European industries and SMEs in two key economic sectors.

Descriptive keywords:	Wastewater Treatment; Wastewater Recycling; Nutrient Recovery; Agriculture; Demonstrative Application
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Project Website:	<a href="https://water2return.eu/">https://water2return.eu/</a> <a href="https://cordis.europa.eu/project/rcn/210179_en.html">https://cordis.europa.eu/project/rcn/210179_en.html</a>
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Key Deliverables/Publications and Links

- Demonstrator implementation at real scale – Development of a demonstrative application for slaughterhouse wastewater treatment and large-scale nutrient recovery in a real case study, the slaughterhouse “Matadero del Sur” in Salteras (Spain).
- Fertilisers and biostimulants manufacturing – Manufacturing of organic-source fertilisers and biostimulants in production lines built up within Water2Return project timeframe. They will be manufactured in Spain and tested in Slovenia, Romania, Lithuania and Spain.
- Reduction of the environmental adverse effects of nutrient emissions and wastewater discharge – Nutrients recovery rates of 90-95% (N and P) and reduction of wastewater discharged to the environment by 90%, thus decreasing water bodies pollution and other related environmental problems. Moreover, the treated water obtained can be further used, reducing operational costs of the slaughterhouse.
- Reduction of landfilled waste – Reduction of waste diverted to landfills by 80%. After removing the organic elements from the slaughterhouse wastewater, the remaining inorganic fraction (less than 20% of the wastewater composition) will be the only residual element taken to landfill
- Energy self-sufficiency of slaughterhouses wastewater treatment plants – Biogas upgrading and valorisation will allow achieving self-sufficiency rates and saving of up to

25% in the slaughterhouse, with the consequence reduction of CO<sub>2</sub> and greenhouse gas emissions.

- Promotion of a wide and fast market uptake of Water2Return processes and products – Targeted business plans will be implemented with the aim of creating new business opportunities and green jobs around nutrient recovery and recycling technologies, especially for SMEs in the EU. The acceptance of the final commercial outcomes by final users will be enhanced through capacity building and awareness raising.

## Action C.7: Sustainable Urban Drainage Systems

### Brief Description of the Concrete Action

The Ministry for Transport, Infrastructure and Capital Projects (MTIP) will be the lead beneficiary responsible for implementing this action.

The implementation of demonstration actions on Sustainable Drainage Systems (SuDS) – DEMOSuDS, as proposed in this action is seen as an opportunity to apply a cost-effective, state-of-the-art technique for sustainable urban drainage and rural drainage measures, and risk reduction and resilience in Malta. This action proposes to design and deploy three examples of SuDS following a wider appraisal in order to assess their suitability to be introduced into the Maltese landscape, thereby setting the needed long-term planning and design guidance for the implementation of SuDS to be replicated according to different contexts and within a wider and more ambitious effort to promote green infrastructure and natural water retaining systems.

The DEMOSuDS action shall consist of a number of sequence-based tasks, intended to follow the normal planning-design-delivery cycle of infrastructural projects, together with other horizontal tasks aimed at ensuring the achievement of the overall objectives of the action, including stakeholder engagement and management, and environmental management and monitoring throughout the entire project cycle. The step-by-step knowledge and strategy building is based on three key stages: firstly, to research the technical possibilities and strategic options using a desk-based study and project planning, developing an overall strategy and assessment tools; secondly, to test these concepts and proposals with the use of field modelling through small-scale prototypes that can be researched; and thirdly, through pilot projects devised on the basis of the knowledge and strategic vision gained, supported by monitoring and evaluation. The key stages are supported by the horizontal tasks to achieve the objectives related to dissemination and stakeholder engagement.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.7: Sustainable Urban Drainage Systems
Project Title:	A methodology for optimal sitting of sustainable urban drainage systems. Case study: Universidad de los Andes campus (Conference Paper)
Project Acronym/ID:	Not Applicable
Project Duration:	September, 2017 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1:

	Name: María Nariné Torres Email: mn.torres132@uniandes.edu.co Institution: Universidad de los Andes
<b>Project Summary:</b>  This paper developed a methodology for the selection, sitting and pre-dimensioning of Sustainable Urban Drainage Systems (SUDS). A GIS-based methodology, that requires vector and raster data (i.e. orthophoto, Digital Elevation Model, water table depth, infiltration rate) to delineate watersheds and identify suitable sites for implementing SUDS, was further refined by involving local stakeholder knowledge. Daily rainfall precipitation historical data was used for pre-dimensioning. A lexicographic multi-objective optimisation model was implemented to maximise and/or minimise a set of objective functions: (i) maximisation of the use of runoff water for irrigation purposes, (ii) maximisation of the use of SUDS storage capacity, (iii) minimisation of construction and maintenance costs and, (iv) minimisation of runoff volumes. The methodology was applied to the Universidad de los Andes campus and the obtained results showed that potable water consumption for irrigation purposes can be reduced up to 77% by implementing a total area of 0.15 ha of SUDS. The optimal solution for a subset of feasible sites resulted in 6 SUDS sites using storm water tree pits and permeable pavements.	
Descriptive keywords:	‘Sustainable Urban Drainage Systems (SUDS)’ ‘Runoff Irrigation’ ‘Linear Optimisation’ ‘Non-potable water consumption’
Project Website:	Not Applicable
<b>Key Deliverables/Publications and Links:</b>  Andrés Felipe Muñoz, A., Torres, M., Fontecha Garcia, J., Rodríguez Sánchez, J. and Zhu, Z. (2017). A methodology for optimal sitting of sustainable urban drainage system. Case study: Universidad de los Andes. In: <i>International Conference on Urban Drainage</i> . [online] Prague, Czech Republic. Available at: <a href="https://www.researchgate.net/publication/319987053_A_methodology_for_optimal_sitting_of_sustainable_urban_drainage_system_Case_study_Universidad_de_los_Andes">https://www.researchgate.net/publication/319987053_A_methodology_for_optimal_sitting_of_sustainable_urban_drainage_system_Case_study_Universidad_de_los_Andes</a> [Accessed 12 Feb. 2018]	

Relevant LIFE IP Concrete Action:	Action C.7: Sustainable Urban Drainage Systems
Project Title:	Modelling of Sustainable Urban Drainage Measures (Scientific Article)
Project Acronym/ID:	Not Applicable
Project Duration:	December, 2014 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts (including contact person's full name and email address)	Contact Person 1: Name: T. Vergroesen Email: vergroe@deltares.nl Institution: Deltares

Project Summary

This paper discusses numerical modelling approaches for three different types of measures commonly used in the Netherlands: green roofs, swale filter drainage systems (swales), and infiltration-transport drainage systems (IT-drains). A combination of physically based and empirical formulae as well as urban hydrologic and hydraulic modelling software was used to assess the effectiveness of the measures.

The analysis has shown that these systems are promising, especially at the scale of the individual measures (a single IT-drain pipe, swale or green roof). Due to non-linearity issues, the up-scaling of such measures to city and neighbourhood levels remained a challenge, thus further research is required. The modelling concepts for green roofs and swales were applied in a synthetic case study to illustrate the possible effects of SUDS on the reduction of inundation volumes in urban areas. The case study consisted of an imaginary urban area with properties resembling average urban areas in the Netherlands.

These storm water infiltration systems have been developed to reduce flooding risk or to increase groundwater recharge. As a consequence, software modelling for urban drainage systems enabled water authorities and municipalities to assess the impact of sustainable urban drainage measures 'SUDS' on local flood hazards.

Descriptive keywords:	'Sustainable Urban Drainage Systems (SUDS)' 'Hydrology' 'Infiltration' 'Evaporation' 'SOBEK'
Project Website:	Not Applicable

Key Deliverables/Publications and Links

Vergroesen, T., Verschelling, E. and Becker, B. (2014). MODELLING OF SUSTAINABLE URBAN DRAINAGE MEASURES. *Revista de Ingeniería Innova*, [online] 8, pp.pp. 1 - 16. Available at: [https://www.researchgate.net/publication/273633533\\_MODELLING\\_OF\\_SUSTAINABLE\\_URBAN\\_DRAINAGE\\_MEASURES](https://www.researchgate.net/publication/273633533_MODELLING_OF_SUSTAINABLE_URBAN_DRAINAGE_MEASURES) [Accessed 12 Feb. 2018].

Relevant LIFE IP Concrete Action:	Action C.7: Sustainable Urban Drainage Systems
Project Title:	Pilot Project - Atmospheric Precipitation - Protection and efficient use of Fresh Water: Integration of Natural Water Retention Measures in River Basin management
Project Acronym/ID:	NWRM
Project Duration:	5 <sup>th</sup> September 2013 – 5 <sup>th</sup> November 2014
Project Status:	Completed
Funding Programme:	Lump Sum Basis
Key Contacts:	<a href="http://nwrn.eu/contact">http://nwrn.eu/contact</a>
<u>Project Summary</u>	



The main objective of the NWRM pilot project was to improve the knowledge base on natural water retention measures (NWRM) and their delivery as part of policy implementation. The project has also exchanged knowledge at various stakeholder levels and promoted their implementation in River Basin Management Plans (RBMPs) and first Flood Risk Management Plans (FRMPs).

The project achieved the following objectives:

(i) Collected state-of-the-art knowledge, available data and information and best practices in the application of natural water retention measures (NWRM) to manage fresh water precipitation across the EU;

(ii) Provided a detailed assessment of effectiveness, costs and benefits of NWRM, which supported further scenario modelling with the Joint Research Centre (JRC) integrated water modelling platform;

(iii) Developed further a catalogue of measures and case studies, and ensured its continued maintenance;

(iv) Linked NWRM projects and good practice examples across a range of geographies and land use and shared past experiences;

(v) Contributed to the Water Framework Directive Common Implementation Strategy (WFD CIS) and identified or created operational tools that can be used at national, river basin and/or local level to facilitate the inclusion of NWRM in the RBMPs and FRMPs.

Descriptive keywords:	'Biophysical impact' 'Runoff' 'Water retention' 'Effectiveness'
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Project Website:	<a href="http://nwrn.eu/">http://nwrn.eu/</a>
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Key Deliverables/Publications and Links:

NWRM Final Report

Relevant LIFE IP Concrete Action:	Action C.7: Sustainable Urban Drainage Systems
Project Title:	The Glasgow sustainable urban drainage system management project: Case studies (Belvidere hospital and Celtic FC stadium areas) – (Article)
Project Acronym/ID:	Not Applicable
Project Duration:	2006 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Prof. Miklas Scholz Email: <a href="mailto:m.scholz@salford.ac.uk">m.scholz@salford.ac.uk</a>

	Institution: University of Salford, Manchester
<p><u>Project Summary</u></p> <p>The project showed how sustainable urban drainage systems (SUDS) can contribute to the overall catchment dynamics of cities such as Glasgow, which ultimately relieved stress on the current predominantly combined sewer system. The project aim was to come up with SUDS demonstration areas (case studies) that were representative of different sustainable drainage techniques and different types of areas available for development and regeneration.</p> <p>The project has achieved the following objectives:</p> <ol style="list-style-type: none"> <li>1. Identified variables that determined the suitability of a given site for the implementation of SUDS;</li> <li>2. Identified suitable SUDS sites within Glasgow;</li> <li>3. Classified qualitatively and quantitatively sites suitable for different SUDS technologies;</li> <li>4. Developed a general outline for a SUDS decision support key and a SUDS decision support matrix;</li> <li>5. Identified representative SUDS technologies for representative sites that were used for demonstration purposes;</li> <li>6. Provided a detailed design and management guidelines, and a brief cost–benefit analysis for representative sites and representative SUDS techniques to be used for information and education purposes;</li> <li>7. Assessed the soil contamination and the associated impact on environmental health.</li> </ol> <p>The preliminary designs of SUDS helped to understand the challenges of holistic catchment management, diffuse pollution, and the linking scales in catchment management. It was forecasted that the implementation of SUDS would help to relieve the local sewer system. Subsequently it would also allow for more regeneration activities to take place.</p>	
Descriptive keywords:	‘Sustainable Urban Drainage System’ ‘Brownfield’ ‘Soil contamination’ ‘Heavy metal’
Project Website:	<a href="http://usir.salford.ac.uk/20752/1/SCHOLZ.pdf">http://usir.salford.ac.uk/20752/1/SCHOLZ.pdf</a>
<p><u>Key Deliverables/Publications and Links</u></p> <p>Scholz, M., Corrigan, N. and Yazdi, S. (2006). The Glasgow sustainable urban drainage system management project: Case studies (Belvidere hospital and Celtic FC stadium areas). [online] Available at: <a href="http://usir.salford.ac.uk/20752/1/SCHOLZ.pdf">http://usir.salford.ac.uk/20752/1/SCHOLZ.pdf</a> [Accessed 14 Feb. 2018].</p>	

Relevant LIFE IP Concrete Action:	Action C.7: Sustainable Urban Drainage System
Project Title:	The Barriers and Opportunities to the Retrofit of Sustainable Urban Drainage Systems (SUDS) Towards Improving Flood Risk Mitigation in Urban Areas in the UK - (Conference paper)
Project Acronym/ID:	Not Applicable

Project Duration:	September, 2017 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: David Proverbs Email: <a href="mailto:david.proverbs@bcu.ac.uk">david.proverbs@bcu.ac.uk</a> Institution: Birmingham City University
<u>Project Summary</u>  <p>The aim of this study was to examine the barriers and opportunities in the retrofitting of sustainable urban drainage systems (SuDS) to appraise their effectiveness in the mitigation of flood risk. The study has investigated the feasibility of the implementation of SUDS. Specifically, it has examined a range of multiple benefits from retrofitting SuDS such as: the enhancement of air quality; and the identification of a number of potential barriers, including the lack of trust in such systems. However, the study suggests that further research is required to identify the monetary and non-monetary benefits of SuDS as part of an integrated approach of flood risk management.</p>	
Descriptive keywords:	'Flooding' 'Systematic review' 'Retrofit SuDS' 'Benefits' 'Barriers'
Project Website:	Not Applicable
<u>Key Deliverables/Publications and Links</u>  <p>Oladunjoye, O., Proverbs, D. and Collins, B. (2017). The Barriers and Opportunities to the Retrofit of Sustainable Urban Drainage Systems (SUDS) Towards Improving Flood Risk Mitigation in Urban Areas in the UK. In: <i>International Sustainable Ecological Engineering Design for Society (SEEDS)</i>. [online] Leeds. Available at:  <a href="https://www.researchgate.net/publication/319718484_THE_BARRIERS_AND_OPPORTUNITIES_TO_THE_RETROFIT_OF_SUSTAINABLE_URBAN_DRAINAGE_SYSTEMS_SUDS_TOWARDS_IMPROVING_FLOOD_RISK_MITIGATION_IN_URBAN_AREAS_IN_THE_UK">https://www.researchgate.net/publication/319718484_THE_BARRIERS_AND_OPPORTUNITIES_TO_THE_RETROFIT_OF_SUSTAINABLE_URBAN_DRAINAGE_SYSTEMS_SUDS_TOWARDS_IMPROVING_FLOOD_RISK_MITIGATION_IN_URBAN_AREAS_IN_THE_UK</a> [Accessed 14 Feb. 2018].</p>	

Relevant LIFE IP Concrete Action:	Action C.7: Sustainable Urban Drainage Systems
Project Title:	Cost-benefit of SUDS retrofit in urban areas
Project Acronym/ID:	Not Applicable
Project Duration:	November, 2007 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Authors: Gordon-Walker, S., Harle, T., Naismith, I.

Project Summary

The study has taken the implementation of traditional drainage techniques (hard drainage systems into sewage systems or separate surface drainage systems) as a baseline, and compared the costs and benefits of replacing traditional systems with SUDS. An initial assessment of SUDS cost and benefits showed that permeable paving costs were less on a lifecycle basis than those of traditional surfaces and have reduced maintenance costs. Water butts provide economic benefits via savings in water costs. On the other hand, it was found that other types of SUDS such as swales and filter drains tend to show a cost-benefit ratio of less than 1, therefore implying that they cost more and provide fewer benefits. Where relevant, these systems were applied at the end-of-life of the current traditional systems or hard surfaces. The available data on surface areas for undertaking SUDS retrofitting came from the Generalised Land Use database from the Communities and Local Government of the United Kingdom.

Descriptive keywords:	'Drainage' 'Paving' 'Flooding' 'Water pollution' 'Costs and benefits'
Project Website:	Not Applicable

Key Deliverables/Publications and Links

Environment Agency (2007). *Cost-benefit of SUDS retrofit in urban areas*. [online] Environment Agency. Available at: [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/290993/scho04\\_08bnxz-e-e.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/290993/scho04_08bnxz-e-e.pdf) [Accessed 14 Feb. 2018].

Relevant LIFE IP Concrete Action:	Action C.7: Sustainable Urban Drainage System
Project Title:	Feasibility Assessment of Sustainable Urban Drainage Systems (SUDS) in Ho Chi Minh city using an Analytic Hierarchy Process (AHP) Approach (Conference Paper)
Project Acronym/ID:	Not Applicable
Project Duration:	December, 2015 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Ho Huu Loc Email: ho.huu.45z@st.kyoto-u.ac.jp Institution: Kyoto University, Japan
<u>Project Summary</u>	
<p>The objective of this research was to assess another approach for flood control measures, namely Sustainable Urban Drainage Systems (SUDS), with application to the Nhieu Loc - Thi Nghe Basin, located in the central part of Ho Chi Minh City. An Analytic Hierarchy Process (AHP) approach was used and the addressed criteria were inundation reduction capacity, pollutant removal capacity,</p>	

costs, and public preferences. The results of simulations run on the Personal Computer Storm Water Management Model (PCSWMM), and interviews with 140 households, were used to assess the efficacy and acceptability of four of the most popular SUDS: rainwater harvesting, green roofs, urban green spaces and pervious pavements. The results were then fed into a Multi Criteria Analysis (MCA) Framework developed by an Analytic Hierarchy Process (AHP) approach. In general, SUDS, such as pervious pavements and urban green spaces, were often chosen over individual options (options that can be implemented on a household basis), such as rainwater harvesting and green roofs. This suggested that for the achievement of technical and social benefits, the application of SUDS should start from the installation of infrastructure that targets larger areas, before moving on to smaller systems that can be applied on a household basis.

Descriptive keywords:	'Urban Flooding' 'Sustainable Urban Drainage Systems (SUDS)' 'Multi Criteria Analysis (MCA)' 'Analytic Hierarchy Process (AHP)'
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Project Website:	Not Applicable
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#### Key Deliverables/Publications and Links

Loc, H., Shimizu, Y., Nguyen, H., Nguyen, T. and Kusakabe, T. (2015). Feasibility Assessment of Sustainable Urban Drainage Systems (SUDS) in Ho Chi Minh City using Analytic Hierarchy Process (AHP) approach. In: *World Engineering Conference and Convention*. [online] Kyoto. Available at: [https://www.researchgate.net/publication/285581808\\_Feasibility\\_Assessment\\_of\\_Sustainable\\_Urban\\_Drainage\\_Systems\\_SUDS\\_in\\_Ho\\_Chi\\_Minh\\_City\\_using\\_Analytic\\_Hierarchy\\_Process\\_AHP\\_approach](https://www.researchgate.net/publication/285581808_Feasibility_Assessment_of_Sustainable_Urban_Drainage_Systems_SUDS_in_Ho_Chi_Minh_City_using_Analytic_Hierarchy_Process_AHP_approach) [Accessed 14 Feb. 2018].

## Action C.8: Development of a Managed Aquifer Recharge Scheme in the Pwales Groundwater Body

### Brief Description of the Concrete Action

The Lead Beneficiary for this action is the WSC who will be responsible for the overall coordination and implementation of the action.

This action proposes the application of a Managed Aquifer Recharge scheme within the Pwales aquifer system, located in the northern region of the island of Malta. This aquifer system, due to its hydrological isolation and anthropogenically highly impacted nature has been identified in the studies leading to the formulation of Malta's 2<sup>nd</sup> River Basin Management Plan as one of the ideal sites for the undertaking of an initial application of MAR techniques on a groundwater body scale.

From a logistical perspective, the recharge area of the groundwater body lies along the main distribution network from the Malta North New Water Polishing plant, which ensures the availability of recharge waters in periods of low water demand by the agricultural sector. The recharged high-quality water is expected to flow through the narrow saturated zone characterising this body of groundwater and flush out conventional pollutants such as chlorides and nitrates which are found in high levels in this groundwater body, reflecting the intense agricultural activities undertaken in its recharge area.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	C.8: Development of a Managed Aquifer Recharge Scheme in the Pwales Groundwater Body
Project Title:	MAR spreading method in Alice Springs (Australia)
Project Acronym/ID:	igrac
Project Duration:	2008 - present
Project Status:	Ongoing
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Dr. Declan Page Email: Institution: University of South Australia
<u>Project Summary</u>  This study is intended to show what is needed for the various stages of risk assessment for projects of different types with the aim of making guidelines as easy as possible to understand and use by proponents and regulators. It provides model risk assessments and descriptions of the investigations to support them, which could be used as conceptual templates for several types of projects.	
Descriptive keywords:	Risk assessment, guidelines, MAR.
Project Website:	<a href="http://un-igrac.org">un-igrac.org</a>
<u>Key Deliverables/Publications and Links</u> Managed Aquifer Recharge case study risk assessments. <a href="http://www.clw.csiro.au/publications/waterforahealthycountry/2010/wfhc-MAR-case-study-risk-assessments.pdf">http://www.clw.csiro.au/publications/waterforahealthycountry/2010/wfhc-MAR-case-study-risk-assessments.pdf</a>	

Relevant LIFE IP Concrete Action:	C.8: Development of a Managed Aquifer Recharge Scheme in the Pwales Groundwater Body
Project Title:	Seawater intrusion barrier in the deltaic Llobregat aquifer (Barcelona, Spain)
Project Acronym/ID:	igrac
Project Duration:	2007 - present
Project Status:	Ongoing
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Felip Ortuño Gobern Email: <a href="mailto:fjortuno@gencat.cat">fjortuno@gencat.cat</a>

	Institution: Catalan Water Agency (ACA, Agència Catalana de l'Aigua).
<u>Project Summary</u>  <p>The main aquifer of the Llobregat Delta (Barcelona, Spain) is affected by seawater intrusion processes since the 1960s. The Catalan Water Agency is currently promoting several actions of artificial aquifer recharge, including the construction of a positive hydraulic barrier in order to stop the advance of the seawater intrusion. Such a positive hydraulic barrier works by injecting reclaimed water in 14 wells. This is the first time that a project of this type is performed in Spain and it is also pioneer in Europe. The positive hydraulic barrier produces the rise of the groundwater head near the coast in order to halt seawater penetration inland. The injected reclaimed water comes from the WWTP of the Baix Llobregat after passing through several treatments (ultrafiltration, reverse osmosis and disinfection). The pilot phase of the project has been working during the last 3 years. Hydrogeochemical analyses show highly positive results and is effectively reducing the salt water intrusion process. Substantial improvement of the groundwater quality has been observed in wells surrounding the injection points and no clogging has appeared. Currently the whole planned project is under operation.</p>	
Descriptive keywords:	Salt water intrusion, treated wastewater, valley aquifer
Project Website:	<a href="http://www.un-igrac.org">www.un-igrac.org</a>
Key Deliverables/Publications and Links (name of each deliverable together with a link) <ul style="list-style-type: none"> <li>Seawater intrusion barrier in the deltaic Llobregat aquifer (Barcelona, Spain): performance and pilot phase results.  <a href="https://upcommons.upc.edu/bitstream/handle/2117/12101/5431835.pdf">https://upcommons.upc.edu/bitstream/handle/2117/12101/5431835.pdf</a> </li> </ul>	

Relevant LIFE IP Concrete Action:	C.8
Project Title:	Managed Aquifer Recharge in the Botany aquifer
Project Acronym/ID:	igrac
Project Duration:	2006-
Project Status:	Ongoing
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Alexandra Conry Email: <a href="mailto:Alexandra.Conry@unisa.edu.au">Alexandra.Conry@unisa.edu.au</a> Institution: University of South Australia
<u>Project Summary</u>	

The Botany aquifer is the only significant aquifer in the Sydney region. UNSW extracts bore water from the aquifer for use in irrigation, toilet flushing, cooling towers and heat exchangers. In 2006, a Managed Aquifer Recharge (MAR) scheme was set up at UNSW to counter-balance increased abstraction of groundwater. Balancing extraction with recharge is important to protect the aquifer, ensure water supplies are available over the long term and to prevent consolidation and settlement of the ground surface.

Descriptive keywords:	Irrigation, MAR, extraction balance
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Project Website:	<a href="http://un-igrac.org">un-igrac.org</a>
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#### Key Deliverables/Publications and Links

- Managed Aquifer Recharge in the Botany Aquifer.  
[http://www.connectedwaters.unsw.edu.au/sites/all/files/MAR\\_Botany.pdf](http://www.connectedwaters.unsw.edu.au/sites/all/files/MAR_Botany.pdf)

Relevant LIFE IP Concrete Action:	C.8
Project Title:	Beenyup/Craigie Groundwater Replenishment Trial
Project Acronym/ID:	igrac
Project Duration:	2013-present
Project Status:	Ongoing
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Russell Martin Email: <a href="mailto:rmartin@wga.com.au">rmartin@wga.com.au</a> Institution: Wallbridge Gilbert Aztec Pty Ltd

#### Project Summary

The aim of this study is to produce a 2nd clogging monograph ideally ready for ISMAR10, Madrid May 2019. The main focus of this on methods to manage clogging in MAR operations. Papers are invited to form chapters within this monograph. This applies to infiltration systems and well injection. As a related objective, papers are needed to help move towards standardization of methods to predict clogging for different source water treatment processes for a particular soil or aquifer.

Descriptive keywords:	Clogging, infiltration systems, well injection
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Project Website:	<a href="http://un-igrac.org">un-igrac.org</a>
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#### Key Deliverables/Publications and Links

- Clogging issues associated with managed aquifer recharge methods.  
[https://recharge.iah.org/files/2015/03/Clogging\\_Monograph.pdf](https://recharge.iah.org/files/2015/03/Clogging_Monograph.pdf)



Relevant LIFE IP Concrete Action:	C.8
Project Title:	Monitoring of the managed aquifer recharge (MAR) system by treated wastewater reuse
Project Acronym/ID:	ISMAR-10
Project Duration:	2004- 2016-
Project Status:	Ongoing
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Achilleos Maria Email: axilleosmaria@gmail.com Institution: Water Development Department, Ministry of Agriculture, Rural Development and Environment, 100 - 110 Kennenty Avenue, 1047 Pallouriotissa, Nicosia, Cyprus
<u>Project Summary</u>  <p>Managed Aquifer Recharge (MAR) is becoming an attractive water management option, with more than 230 sites operating in Europe. A main advantage of MAR technology is its flexibility and applicability to different scales and purposes. The quality of the produced water for irrigation processes is strongly dependent on the aquifers hydrogeochemical characteristics and on the MAR design and operation [1]. Two MAR systems in two different sites are currently in operation in Cyprus. The first one is in Paphos area and enriches the Ezousa aquifer with tertiary treatment water since February 2004, while the other is in Limassol area and enriches the Akrotiri aquifer with tertiary treatment water since February 2016. Specifically, the second one recharges the Kouris Delta region of the Akrotiri aquifer, with tertiary treated water from the Sewerage Board of Limassol Amathus in order to improve quantitative and qualitative parameters of the aquifer water. In this project, two sets/systems of 17 total enrichment ponds are used to store the recycled water that are in the Kouris basin. Currently, Akrotiri Aquifer tertiary treated water is recharged during the winter, through 4 of the 10 upstream enrichment ponds along the riverbed, while the other 7 enrichment ponds are located downstream. The quantities of recycled water discharged in the Akrotiri aquifer were 847,340 m3 in 2016 and 1566,520 m3 in 2017. However, during the irrigation period, groundwater is pumped for irrigation purposes from boreholes located nearby.</p>	
Descriptive keywords:	Tertiary treated water, Infiltration pond
Project Website:	<a href="http://ismar10.net">ismar10.net</a>
Key Deliverables/Publications and Links (name of each deliverable together with a link) <ul style="list-style-type: none"> <li>Monitoring of the managed aquifer recharge (MAR) system by treated wastewater reuse (Akrotiri Limassol, Cyprus)</li> </ul>	

Relevant LIFE IP Concrete Action:	C.8
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Project Title:	ASR infrastructure on Rosedale Golf Course, with stormwater dam on left
Project Acronym/ID:	igrac
Project Duration:	2010-present
Project Status:	Ongoing
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Dr. Peter Dillon Email: <a href="mailto:peter.dillon@csiro.au">peter.dillon@csiro.au</a> Institution: Western Sydney University
<u>Project Summary</u>  <p>This investigation of aquifer storage and recovery (ASR) of stormwater at Rosedale Golf Club in Aspendale, a south-eastern suburb of Melbourne, is unique in that the aquifer has the lowest known transmissivity of any aquifer used for ASR. The Werribee Formation target aquifer was absent in that location and the underlying fractured bedrock containing brackish groundwater was used instead. This highly challenging aquifer restricts the rate and volume of recharge, requires a high quality of water for injection and produces a blend of recovered water of a salinity that requires dilution in the stormwater harvesting dam to enable its use for irrigation. Urban stormwater was harvested from the Centre Swamp Drain using a sump with pumps to fill a stormwater dam with about 10ML of active capacity. The stored water could be pumped into the irrigation system that watered the golf course, or alternatively it could be used to recharge the aquifer for subsequent recovery to the dam. After a successful ASR trial with cartridge-filtered mains water, a series of candidate treatments was tested and ultimately a cartridge filter, ultrafiltration and granular activated carbon filtration were selected and installed in a package treatment plant provided by Orica. Although there were typical teething problems with the treatment plant and also with well head instrumentation that provided a web-based data acquisition system that allowed remote observation of the performance of the ASR system, these were overcome and operations normalised.</p>	
Descriptive keywords:	ASR system, stormwater
Project Website:	<a href="http://un-igrac.org">un-igrac.org</a>
<u>Key Deliverables/Publications and Links</u> <ul style="list-style-type: none"> <li>Developing Aquifer Storage and Recovery (ASR) Opportunities in Melbourne – Rosedale ASR demonstration project final report. <a href="https://publications.csiro.au/rpr/download?pid=csiro:EP103253&amp;dsid=DS3">https://publications.csiro.au/rpr/download?pid=csiro:EP103253&amp;dsid=DS3</a></li> </ul>	

Relevant LIFE IP Concrete Action:	C.8
Project Title:	Well, Shaft and Borehole Recharge in East Meadow (USA)
Project Acronym/ID:	igrac

Project Duration:	1982-1984
Project Status:	Completed
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Dr. Herman Bouwer Email Institution: U.S. Water Conservation Laboratory, U.S. Dept. of Agriculture in Phoenix
<u>Project Summary</u>  <p>Achieving a sustainable, reliable drinking water supply has emerged in recent years as an increasingly important goal, not only in the United States but also worldwide. This is being driven by population growth, increasing water demands, declining groundwater levels, contamination of water sources, greater awareness of adverse environmental impacts associated with current water supply practices, concern regarding the potential adverse impacts of global warming, and many other factors. Among the many ways that are being applied to achieve this goal, managed aquifer recharge (MAR) is proving to be viable and cost-effective. During times when excess water is available and of suitable quality, it is recharged into an aquifer using either infiltration through surface soils or recharge through wells. When stored water is needed it is recovered. The aquifer is utilized as a very large storage reservoir, storing water for periods of as short as a few hours to as long as many years.</p>	
Descriptive keywords:	Managed Aquifer Recharge
Project Website:	<a href="http://un-igrac.org">un-igrac.org</a>
<u>Key Deliverables/Publications and Links</u> <ul style="list-style-type: none"> <li>Design, Operation, and Maintenance for Sustainable Underground Storage Facilities. <a href="https://publications.csiro.au/rpr/download?pid=csiro:EP103253&amp;dsid=DS3">https://publications.csiro.au/rpr/download?pid=csiro:EP103253&amp;dsid=DS3</a></li> </ul>	

Relevant LIFE IP Concrete Action:	C.8
Project Title:	Migration of pharmaceuticals from the Warta River to the aquifer at a riverbank filtration
Project Acronym/ID:	ISMAR-10
Project Duration:	2016-present
Project Status:	Ongoing
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Roksana Kruć Email: <a href="mailto:roksana.kruc@amu.edu.pl">roksana.kruc@amu.edu.pl</a>

		Institution: Adam Mickiewicz University in Poznan, Institute of Geology, Department of Hydrogeology and Water Protection, ul. Bogumiła Krygowskiego 12, 61-680 Poznań
<p><u>Project Summary</u></p> <p>Riverbank filtration (RBF) systems are widely used for drinking water supplies. The infiltration of surface water to groundwater systems and water passage through the aquifer media cause improvements in water quality by a set of processes including: sorption, redox processes, and biodegradation [1, 2]. The mixing of bank filtrates with ambient, usually unpolluted groundwater, also takes place [3, 4]. Nevertheless, the quality of bank filtrate is strongly dependent on surface water quality. Currently, it is extremely important due to emerging contaminant (e.g., pharmaceuticals) detection in river (source) water. The occurrence of pharmaceuticals (such as antibiotics, analgesics, blood lipid regulators, contrast agents) has been studied all over the world in surface and also in bank filtrate [5, 6, 7]. RBF system can be used as a natural water treatment method [8]. This can be achieved if the travel time (i.e., time of water passage from surface water to wells) is long enough to remove or considerably reduce the contaminants from the bank filtrates [2,8,9].</p> <p>The goals of the research presented are determination of the pharmaceuticals in both river water and bank filtrates and investigation of pharmaceutical removal rates.</p>		
Descriptive keywords:		River bank filtration, drinking water supplies, pharmaceutical pollutants
Project Website:		<a href="http://ismar10.net">ismar10.net</a>
<p><u>Key Deliverables/Publications and Links</u></p> <ul style="list-style-type: none"> <li>• Migration of pharmaceuticals from the Warta River to the aquifer at a riverbank filtration site in Krajkowo (Poland).</li> </ul>		

Relevant LIFE IP Concrete Action:	C.8
Project Title:	Reclaimed water quality improvement by means of MAR and nature based solutions from local industrial reuse
Project Acronym/ID:	ISMAR-10
Project Duration:	2015-present
Project Status:	Ongoing
Funding Programme:	Not applicable
Key Contacts:	Contact Person 1: Name: Fernández Escalante Email: <a href="mailto:jsss@tragsa.es">jsss@tragsa.es</a> Institution: Tragsatec
<p><u>Project Summary</u></p> <p>Alcazarén is the Northernmost MAR site in Los Arenales Aquifer (Castilla y León, Spain). Three types of water sources are used for recharge: a transport pipe with surface water diverted from Pirón River dam through a River Bank Filtration System (RBF), run-off water from a canal collecting</p>	

occasional drainage from Pedrajas Village streets and recycled water from Pedrajas WWTP. Surface water from the dam has been unavailable for the last years due to legal issues about water rights, so the percentage of recycled water has been higher than originally designed, and consequently, dilution rate of reclaimed water with freshwater has decreased. All available sources (river, WWTP and run-off) are mixed within a chamber, where different types of organic filters have been tested (post-treatment) previous to MAR occurs through three infiltration canals in an irrigation area. Selection of materials for filtering was based on low cost inversion and the availability in the area (pinewood industry). Tests have successfully validated the use of both, inorganic (siliceous and calcareous gravel, grit and sand) and reactive organic (pine bark and pine rachis into geotextile sacks) filters, removing certain pollutants from reclaimed water. 17 parameters were observed and 16 had a clear improvement. It is also worth mentioning that after several weeks of continuous post-treatment and recharge, the reactive layer was still active. Therefore, this technology is likely to be useful for longer-term applications, despite the small scale of the experiment and the short time of interaction. The project demonstrated that physical, chemical and biochemical post-processes associated with MAR plants represent a passive and affordable way to reduce the presence of certain contaminants, with economic and environmental benefits, complemented by further aquifer filtering after MAR. No negative effects have been observed in the infiltration rate as indicated by minimal variation in water levels in 6 piezometers.

Descriptive keywords:	River bank filtration, run-off water, recycled water
Project Website:	<a href="http://ismar10.net">ismar10.net</a>
<u>Key Deliverables/Publications and Links</u> <ul style="list-style-type: none"> <li>Reclaimed water quality improvement by means of MAR and nature-based solutions from local industrial reuse. The Alcazarén-Pedrajas, system, Valladolid (Spain)</li> </ul>	

## Action C.9: Valley Management Plan

### Brief Description of the Concrete Action

Ambjent Malta will be the lead beneficiary responsible for implementing this action and for coordinating the input of the Ministry for Gozo (MGoz). As the Ministry responsible for major projects and operations carried out in Gozo, the role of MGoz shall entail the implementation of pilot project(s) in Gozo. The Environment Resources Authority shall also provide technical support when necessary.

At least one pilot project in Malta and another in Gozo will be carried out. The Catchment Modelling Action will not only provide a clear vision for all the catchments in the Maltese Islands but will also develop a classification system where valleys are delineated according to their particular environmental functions and values. Consequently, the Master Plans will provide technical guidelines for major catchments in Malta and Gozo with specific proposals for restoration and management for various sub-catchments. Thus, pilot projects will follow the recommendations presented by these plans. During the implementation of this sub-action, the measures and methodologies adopted in the pilot sites will be monitored for effectiveness so that future projects (during the After-Life phase of the project) will fully contribute to the protection and enhancement of the functions and values provided by valley systems.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.9 – Valley Management Plan
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Project Title:	LIFE REWAT - Sustainable WATER management in the lower Cornia valley through demand REDuction, aquifer REcharge and river REstoration
Project Acronym/ID:	<b>LIFE14 ENV/IT/001290</b>
Project Duration:	2015 - 2020
Project Status:	Ongoing
Funding Programme:	LIFE
Key Contacts:	Project Manager: Alessandro Fabbri Tel: 39 0565 85761 Email: alessandro.fabbri@cibtoscanacosta.it
<p><u>Project Summary</u></p> <p>The principle objective of the LIFE REWAT project is to put in place, following a participatory approach, a strategy for integrated water resources management at sub-catchment level, proposing a governance model for sustainable development of the lower Val di Cornia.</p> <p>The specific objectives of the project are to:</p> <ul style="list-style-type: none"> <li>Create a central knowledge hub</li> <li>Raise awareness on sustainable water usage</li> <li>Demonstrate practical applications for sustainable water management and aquifer recharge</li> <li>Develop governance models</li> <li>Co-sign stakeholders into a 'river basin contract'</li> </ul> <p>Expected results:</p> <ul style="list-style-type: none"> <li>A reduction of water consumption by about 10% in the civil water supply;</li> <li>A reduction of water consumption by about 20% in agriculture;</li> <li>A reduction of water consumption by about 20% through the reduction and sustainable management of storm water in urban areas;</li> <li>An estimated water infiltration of at least 360 000 m<sup>3</sup>/year due to the installation of a managed aquifer recharge facility;</li> <li>An increase of the current infiltration rate by at least 10% due to morphological restoration of a stretch of the Cornia river; and</li> <li>An improvement of the ecological status of the related water body due to geomorphologic restoration of said stretch of the Cornia river.</li> </ul>	
Descriptive keywords:	Aquifer, Ecology, Sustainability, Environment, Catchment
Project Website:	<a href="http://www.liferewat.eu/">http://www.liferewat.eu/</a>
<p><u>Key Deliverables/Publications and Links</u></p> <p>Poster  <a href="http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&amp;rep=file&amp;fil=REWAT_Leaflet_EN.pdf">http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&amp;rep=file&amp;fil=REWAT_Leaflet_EN.pdf</a> </p>	

Website  
<http://www.liferewat.eu/>  
 Twitter  
<https://twitter.com/RewatLife>  
 Facebook  
<https://www.facebook.com/Progetto-Life-Rewat-338457186278460/>  
 Guidelines – Manual  
[http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=REWAT\\_Guideline\\_EN.pdf](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=REWAT_Guideline_EN.pdf)  
 Technical Report  
[http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=REWAT\\_technical-report\\_IT.pdf](http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=REWAT_technical-report_IT.pdf)

Relevant LIFE IP Concrete Action:	Action C.9 – Valley Management Plan
Project Title:	LIFE BELINI - Belgian Initiative for making a leap forward towards good status in the river basin of the Scheldt
Project Acronym/ID:	LIFE15 IPE/BE/000014
Project Duration:	2016 -2026
Project Status:	Ongoing
Funding Programme:	LIFE
Key Contacts:	Contact person: Lindsay GEERTS Tel: 0032 471792207 Email: l.geerts@vmm.be
<u>Project Summary</u>  The project targets a representative area in the Scheldt International River Basin District. The area is affected negatively by anthropogenic influences such as urban wastewater, inflow of agricultural nutrients, industrial areas and a high diversity of water users. The project aims to address environmental pressures on the basin through capacity building, pilot studies and awareness-raising. Actions specifically addressing climate change, biodiversity and restoration efforts are included within the project. Ecosystem service enhancement is stated as a complementary action. The main aim of the project is to achieve the WFD good status for the water bodies within the selected district. Integrated river basin management will be implemented along with pre-existing Flood Directive and local action plans.	
Descriptive keywords:	River, Basin, Integrated, Management, WFD
Project Website:	<a href="https://life-belini.be/?lang=en">https://life-belini.be/?lang=en</a>
<u>Key Deliverables/Publications and Links</u>  Workshop: Exemptions in the Water Framework Directive <a href="https://life-belini.be/belini_wkshop_16102018_final_web/">https://life-belini.be/belini_wkshop_16102018_final_web/</a> Launch event presentations <a href="https://life-belini.be/publications/?lang=en#tab-id-1">https://life-belini.be/publications/?lang=en#tab-id-1</a>	

Relevant LIFE IP Concrete Action:	Action C.9 – Valley Management Plan
Project Title:	REstoring rivers FOR effective catchment Management
Project Acronym/ID:	REFORM Project No: 282656
Project Duration:	2011 - 2015
Project Status:	Completed
Funding Programme:	European Union's Seventh Programme for Research, Technological Development and Demonstration under Grant Agreement no. 282656.
Key Contacts:	Dr. Tom Buijse STICHTING DELTARES Tel: +31623879381 E-mail: tom.buijse@deltares.nl
<u>Project Summary</u>  <p>The aims of the project were to create a toolbox for the effective hydromorphological restoration to river reaches. Both hydromorphological, ecological and socio-economic factors are considered. To achieve improvements in river reach status, the project developed protocols for biological monitoring in relation to hydromorphological changes, and support materials for restoration and mitigation measures.</p> <p>Specific objectives include the identification of hydromorphological and biological indicators, create tools and guidelines for restoration measures, review pre-existing data on the topic, pressures mapping and related research, and develop instruments to calculate risk-benefit assessments of river restoration measures.</p>	
Descriptive keywords:	Restoration, River, Ecology, Hydromorphology, Biology
Project Website:	<a href="https://reformrivers.eu/">https://reformrivers.eu/</a>
<u>Key Deliverables/Publications and Links</u>  <p>The full set of deliverables and publications can be found here <a href="https://reformrivers.eu/reform-results">https://reformrivers.eu/reform-results</a>. The following are the most relevant to the AM action in question.</p> <p>Project Leaflet  <a href="https://reformrivers.eu/deliverable-76-project-leaflet-english-version">https://reformrivers.eu/deliverable-76-project-leaflet-english-version</a></p> <p>REFORM Policy Brief No.2 - Challenges for effective river restoration: New insights and tools from REFORM  <a href="https://reformrivers.eu/reform-policy-brief-no2-challenges-effective-river-restoration-new-insights-and-tools-reform">https://reformrivers.eu/reform-policy-brief-no2-challenges-effective-river-restoration-new-insights-and-tools-reform</a></p> <p>Field protocols and associated database for paired river restoration comparison  <a href="https://reformrivers.eu/field-protocols-and-associated-database-paired-river-restoration-comparison">https://reformrivers.eu/field-protocols-and-associated-database-paired-river-restoration-comparison</a></p> <p>Evaluation of hydromorphological restoration from existing data  <a href="https://reformrivers.eu/evaluation-hydromorphological-restoration-existing-data">https://reformrivers.eu/evaluation-hydromorphological-restoration-existing-data</a></p> <p>Inventory of river restoration measures: effects, costs and benefits  <a href="https://reformrivers.eu/inventory-river-restoration-measures-effects-costs-and-benefits">https://reformrivers.eu/inventory-river-restoration-measures-effects-costs-and-benefits</a></p>	



Review on ecological response to hydromorphological degradation and restoration  
<https://reformrivers.eu/review-ecological-response-hydromorphological-degradation-and-restoration>

REFORM Policy Brief No.3 - A fresh look on effective river restoration: Key conclusions from the REFORM project  
<https://reformrivers.eu/reform-policy-brief-no3-fresh-look-effective-river-restoration-key-conclusions-reform-project>

Fact sheets for restoration projects  
<https://reformrivers.eu/fact-sheets-restoration-projects>

Guidebook for the evaluation of stream morphological conditions by the Morphological Quality Index (MQI)  
<https://reformrivers.eu/guidebook-evaluation-stream-morphological-conditions-morphological-quality-index-mqi>

Assessing Restoration Effects on River Hydromorphology Using the Process-based Morphological Quality Index in Eight European River Reaches (Belletti et al. 2018)  
<https://reformrivers.eu/assessing-restoration-effects-river-hydromorphology-using-process-based-morphological-quality-index>

Final report  
<https://reformrivers.eu/results/final-report>

Relevant LIFE IP Concrete Action:	Action C.9 – Valley Management Plan
Project Title:	The INHABIT project: ‘Local hydro-morphology, habitat and RBMPs: new measures to improve ecological quality in South European rivers and lakes’
Project Acronym/ID:	LIFE08 ENV/IT/000413 INHABIT
Project Duration:	2010 - 2013
Project Status:	Completed
Funding Programme:	LIFE
Key Contacts:	Andrea Buffagni Stefania Erba  CNR-IRSA, Water Research Institute Via del Mulino, 19 20047 Brugherio MB Italy  Tel ++39 039 21.694.1 - ++39 039 21.694.208-4 E-mail: inhabit@irsa.cnr.it
<b>Project Summary</b>  The project aimed to target WFD river basin management plans, integrating relevant information and producing suggestions for amendments and improvements. A review of the Biological Quality Elements, their quantification and comparison across sites of varying ecosystem health is proposed within the research packages. Further refining of the ecosystem status classification and technical implementation of WFD required actions, including : researching the influence of discharge-related habitat features on the ecological status; influence of the fluctuations in riparian and shore zone levels on the ecological status of lakes; interaction between hydromorphology, habitats and	

nutrient concentrations as a means of habitat improvement in rivers; large-scale nutrient transport and its implications in the implementations of river basin management plans. All outputs from these research questions are integrated in deliverables intended for direct uptake within pre-existing management plans.

The project, through this new approach based on hydro-morphological, habitat-mediated information, the project contributed to reduce relevant problems in the sector of WFD implementation and ecological status classification such as: i) uncertainty in biological classification ii) strong delay in WFD implementation in large parts of South Europe iii) the difficulty in practically implementing other, more traditional measures iv) the risk of failing in the achievement of good ecological status by 2015.

A direct consideration of temporary rivers is included within the project.

Descriptive keywords:	Research, Integrated River Management, Restoration, Hydromorphology, Ecology
Project Website:	<a href="http://www.life-inhabit.it/">http://www.life-inhabit.it/</a>

#### Key Deliverables/Publications and Links

Presentations and Workshops

<http://www.life-inhabit.it/en/download/inhabit-presentations-deliverables>

Public Reports and Guidelines

<http://www.life-inhabit.it/en/download/public-reports-guidelines>

CARAVAGGIO Software

<http://www.life-inhabit.it/en/download/software>

Site Classification

<http://www.life-inhabit.it/en/download/life-inhabit-data>

Summary of Themes and Results

<http://www.life-inhabit.it/en/inhabit-themes-results>

Relevant LIFE IP Concrete Action:	Action C.9 – Valley Management Plan
Project Title:	Framework for improving water balance and nutrient mitigation by applying small water retention measures
Project Acronym/ID:	FramWat
Project Duration:	2017 - 2020
Project Status:	Ongoing
Funding Programme:	INTERREG
Key Contacts:	TOMASZ OKRUSZKO Project Manager Warsaw University of Life Sciences framwat@levis.sggw.pl
<u>Project Summary</u>	
The project builds on pre-existing frameworks for flood, drought and pollution management. Nature-based solutions and natural (small) water retention measures (N(S)WRM) approaches are	

being explored for their application as replacements or improvements of existing interventions. Ecosystem services in riparian habitats are being prioritised within this research. New tools and technologies are being developed to enable more sustainable and efficient natural methods of water retention. These will be passed on to decision makers for integration within planning frameworks and the upcoming RBMP.

Descriptive keywords:	Nature Based Solutions, Water, Retention, RBMP
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Project Website:	<a href="https://www.interreg-central.eu/Content.Node/FramWat.html">https://www.interreg-central.eu/Content.Node/FramWat.html</a>
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#### Key Deliverables/Publications and Links

O.T1.1 - TOOL: Landscape Valorisation Method (VM) and GIS Tool for identifying locations where N(S)WRM are needed

[https://www.interreg-central.eu/Content.Node/O.T1.1---TOOL--Landscape-Valorisation-Method-\(VM\)-and-GIS.html](https://www.interreg-central.eu/Content.Node/O.T1.1---TOOL--Landscape-Valorisation-Method-(VM)-and-GIS.html)

FroGIS

<https://www.interreg-central.eu/Content.Node/FroGIS.html>

O.T1.2 - TRAINING: Training course on how to use the GIS tool

<https://www.interreg-central.eu/Content.Node/O.T1.2---TRAINING--Training-course-on-how-to-use-the-GIS-.html>

O.T1.3 - PILOT ACTION: testing GIS tool in the pilot catchments

<https://www.interreg-central.eu/Content.Node/O.T1.3---PILOT-ACTION--testing-GIS-tool-in-the-pilot-catc.html>

## Action C.10: Industrial Discharges – Enforcement Augmentation & Sustainability (IDEAS)

### Brief Description of the Concrete Action

The WSC will be the major beneficiary of this action and will be responsible for its overall coordination and implementation. The action also foresees the participation of the Environment and Resources Authority (ERA) who will support the WSC from a regulatory perspective, with the aim of establishing synergies between the action and the environmental permitting framework operated by ERA.

Following the implementation of the initial preparatory action, the main focus of this action will involve the building-up of the technical capacity of the Discharge Permit Unit (DPU) within the WSC, in terms of personnel, equipment, procedures and more in-depth knowledge about the challenges faced by the sewer network. This will allow the DPU to direct its efforts towards those areas which are contributing to lowering the quality of the sewage. Coupled with the increased capacity of the DPU, this will constitute more and better upstream control and enforcement.

The implementation of this action will be undertaken through a number of tasks, each addressing specific identified management issues. These tasks are as follows:

- Task 1: Identification of hot spots
- Task 2: Collaboration with other EU utility companies
- Task 3: Capacity building of the DPU
- Task 4: Launching a Discharge Compliance Scheme

## Related Research Initiatives

Relevant LIFE IP Concrete Action:	C.10
Project Title:	New and emerging challenges and opportunities in wastewater reuse
Project Acronym/ID:	NEREUS
Project Duration:	2014-2017
Project Status:	Completed
Funding Programme:	COST
Key Contacts:	Contact Person 1: Name: Dr. Despo Fatta-Kassinou Email : <a href="mailto:dfatta@ucy.ac.cy">dfatta@ucy.ac.cy</a> Institution : Nireas - International Water Research Center – University of Cyprus
<u>Project Summary</u>  Wastewater reuse is currently considered globally as the most critical element of sustainable water management. Water scarcity, foreseen to aggravate, pushes for maximum utilization of non-conventional water. Although reuse is accompanied by a number of benefits, several potential drawbacks still puzzle scientists. The applied treatments fail to completely remove microcontaminants, antibiotic-resistant bacteria and/or their genes (ARB&Gs). Knowledge on the actual effects of reuse with regard to these aspects is currently not consolidated. This Action will answer critical questions through a European multidisciplinary network, structured in interactive Working Groups (WGs), to achieve: a) identification of the microbiome and mobile antibiotic resistome in treated wastewater, b) assessment of the potential for uptake/transmission of microcontaminants and ARB&Gs in crops, c) determination of effect-based bioassays required for wastewater reuse, d) identification of efficient/economically viable technologies able to meet the current challenges and, e) development of a relevant risk assessment and policy framework. The Action will establish criteria on technologies/assessment methods for wastewater treatment and suggest new effluent quality criteria to overcome current barriers and safeguard the reuse practice. The Action will have a major impact on the enhancement of sustainable wastewater reuse in light of current challenges at technological, economical and societal level.	
Descriptive keywords:	wastewater treatment and reuse, microcontaminants, antibiotic-resistant bacteria and genes, crops' uptake, quality standards and risk assessment
Project Website:	<a href="http://www.nereus-cost.eu/">http://www.nereus-cost.eu/</a>
<u>Key Deliverables/Publications and Links</u>	

Relevant LIFE IP Concrete Action:	C.10
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Project Title:	Sewage biomarker analysis for community health assessment
Project Acronym/ID:	SCORE
Project Duration:	2014 - 2018
Project Status:	Completed
Funding Programme:	COST
Key Contacts:	<p>Contact Person 1:  Name: Kevin Thomas  Email: kevin.thomas@niva.no  Institution : Norwegian Institute for Water Research</p> <p>Contact Person 2:  Name : Sara Castiglioni  Email : sara.castiglioni@marionegri.it  Institution : Mario Negri Institute</p>
<p><u>Project Summary</u></p> <p>Sewage contains the excreted biomarkers of endogenous human metabolism that directly reflects the exposure and stressors placed upon an entire contributing community. The quantitative measurement of these specific biomarkers in sewage from communities allows the averaged patterns of factors related to lifestyle, disease and environment to be used for the assessment of community health. The Action will develop and expand an existing pan-European inter-disciplinary network, bringing together experts from relevant disciplines interested in the application and development of using the quantitative measurement of human biomarkers in sewage to evaluate lifestyle, health and exposure at the community level. In order to achieve its objectives the Action will manage a common Europe-wide testing platform that will develop best practice, provide a significant increase in the comparable spatio-temporal resolution of available data, coordinate the development of new biomarkers in sewage with focus on new psychoactive substances and new biomarkers for the community assessment of factors such as environment, health, lifestyle and diet, and integrate sewage-based approaches with other available metrics. The Action will have a major impact on the development of this emerging field and ensure that the technology is used in a responsible and effective manner and its potentially fully exploited in collaboration with end-users.</p>	
Descriptive keywords:	
Project Website:	<a href="http://score-cost.eu/">http://score-cost.eu/</a>
<u>Key Deliverables/Publications and Links</u>	

Relevant LIFE IP Concrete Action:	C.10
Project Title:	
Project Acronym/ID:	INNOVA-MED

Project Duration:	2007 - 2010
Project Status:	Completed
Funding Programme:	FP6
Key Contacts:	<p>Contact Person 1: Coordinator  Name: Damia Barcelo  Email: dbcqam@cid.csic.es  Institution: Dept. Env Chemistry - Girona</p> <p>Contact Person 2: Project Manager  Name: Mira Petrovic  Email: mpeqam@cid.csic.es  Institution: Dept. Env Chemistry - Girona</p>
<p><u>Project Summary</u></p> <p>Objectives</p> <p>Coordination Action INNOVA-MED aims to coordinate the research activities of ongoing EU and national projects dealing with development of innovative technologies for wastewater treatment and treatment and disposal of sludges and with application of innovative practices for re-use of reclaimed water and to facilitate the transfer and use of knowledge and technology in the MPC.</p> <p>The main objective is to explore the synergies of the research carried out within different programmes and countries (eg. EU, WBC, DEV, NIS, MCP) and to facilitate the communication with researchers and national and regional institutions from the MPC and allow a broad dissemination and transfer of the knowledge/technology/practice to the Mediterranean area.</p> <p>The specific objectives of INNOVA-MED are:</p> <ul style="list-style-type: none"> <li>• to exploit complementarities in research objectives, methodologies and data analysis of ongoing as well recently completed EU and national projects on wastewater treatment and re-use in the EU and MPC in line with the Integrated Water Resources and Allocation Management (IWRAM) priorities indicated in the recommendations of the recent Critical Review of EU-INCO water research projects from FP4 to FP6 (Brussels, EUR 22017, Brussels, 2006)</li> <li>• to facilitate efficient dissemination/exploitation of information and to improve the effectiveness in the transfer and sharing of an integrated and comprehensive knowledge on wastewater treatment and re-use technologies between EU and MPC</li> <li>• to allow access to easy to use information on wastewater treatment and re-use in the Mediterranean region based on effectively share and transfer of the rational extraction of knowledge built and organized during the project</li> <li>• to counteract fragmentation of the research and to improve dissemination of the RTD results, as well as public awareness on the sustainability of water by connecting research with local knowledge, policy institutions and implementing bodies in the Mediterranean region</li> </ul>	
Descriptive keywords:	
Project Website:	<a href="http://www.idaea.csic.es/innova-med/home.htm">http://www.idaea.csic.es/innova-med/home.htm</a>

Key Deliverables/Publications and Links

<http://www.idaea.csic.es/innova-med/reports.htm>

Relevant LIFE IP Concrete Action:	C.10
Project Title:	Advanced bipolar membrane processes for remediation of highly saline waste water streams
Project Acronym/ID:	NEW ED
Project Duration:	2009 - 2012
Project Status:	Completed
Funding Programme:	FP7
Key Contacts:	Contact Person 1: Name: Ing. Jan Stodollick Email: jan.stodollick@avt.rwth-aachen.de Institution: RWTH Aachen University
<u>Project Summary</u> <p>New ED aims at closing industrial water cycles and reducing the amount of waste water streams with highly concentrated salt loads stemming from a broad range of industrial production processes by exploiting the waste components (salts) and transforming them to valuable products. This will be achieved by developing new nanoporous bipolar membranes for electrodialysis using bipolar membranes (EDBM), a new membrane module concept and by integrating this new technology into relevant production processes.</p> <p>The bipolar membrane process produces acids and bases from their corresponding salts by dissociating water at the interface within the bipolar membranes. However, EDBM so far has been applied only in niche markets due to limitations of the current state of membrane and process development. Major drawbacks of the classic EDBM process are low product purity, limited current density and formation of metal hydroxides at or in the bipolar membrane. The objective of this project is to overcome these limitations by developing a new bipolar membrane and membrane module with a new water transport concept into the inner layer of the bipolar membranes.</p> <p>Several promising membrane configurations will be developed and tested. New module concepts will be investigated to exploit the full potential of the new bipolar membrane technique. Integration of the developed membranes and modules into relevant production processes is an essential part of the project.</p> <p>The strategic aim of New ED is in line with the vision document and strategic research agenda put forward in 2006 by WSSTP (Water Supply and Sanitation Technology Platform) on a European level that specifically asks for recovery of materials from brines, treatment of brines from specific processes and development of technologies for treatment of concentrated salt streams.</p>	
Descriptive keywords:	waste water, membrane

Project Website:	<a href="http://www.new-ed.eu/index.php?id=390">http://www.new-ed.eu/index.php?id=390</a>
<u>Key Deliverables/Publications and Links</u> <ul style="list-style-type: none"> <li>• A "Critical review and assessment on the preparation of experimental as well as commercially available bipolar membranes" has been prepared and will be made available through scientific publications. The executive summary summarizes the extent of the review. <a href="http://www.new-ed.eu/uploads/media/NEW_ED_Deliverable_D.1.1_executive_summary.pdf">http://www.new-ed.eu/uploads/media/NEW_ED_Deliverable_D.1.1_executive_summary.pdf</a></li> <li>• A "Market study of potential applications for the developed technologies and products" has been prepared and will be made available through scientific publications. The executive summary summarizes the extent of the review. <a href="http://www.new-ed.eu/uploads/media/NEW_ED_Deliverable_D.4.1_executive_summary.pdf">http://www.new-ed.eu/uploads/media/NEW_ED_Deliverable_D.4.1_executive_summary.pdf</a></li> <li>• This deliverable is a final report of preparation and characterization of structured interfaces in bipolar electrodialysis membranes for enhanced water-splitting productivity. Here the four manufacturing approaches followed within the project were compared and contrasted.</li> <li>• This deliverable is part of WP2 of the project, which dealt with module design and module construction. Here reduction of parasitic current along with design and manufacturing of resistant spacers is reported. CFD computations as well as electrical circuit simulations were performed to help decide upon the most appropriate spacer design. In addition, limiting current density experiments were carried out to evaluate the manufactured spacers.</li> <li>• The report deals with the possibilities of the treatment of large ecologically relevant process and wastewater streams by bipolar electrodialysis systems developed within the New ED project. Here results from a lab-scale study applying the new bipolar membrane concept are presented. The case-study was conducted on the process water of the project partner Bayer Material Science. Bayer process water contains significant amount of sodium chloride which is emitted at the end of the polycarbonate production line.</li> <li>• The final project report. The executive summary summarizes the extent of the report. <a href="http://www.new-ed.eu/uploads/media/New-ED_final-project-report_executive_summary.pdf">http://www.new-ed.eu/uploads/media/New-ED_final-project-report_executive_summary.pdf</a></li> </ul>	

Relevant LIFE IP Concrete Action:	C.10
Project Title:	Waste Water Quality Monitoring
Project Acronym/ID:	WWQM
Project Duration:	2012 - 2015
Project Status:	Completed
Funding Programme:	EIP-Water
Key Contacts:	Contact Person 1: Name: Cros Herrero Jordi Email: <a href="mailto:jcros@adasasistemas.com">jcros@adasasistemas.com</a> Institution : ADASA SISTEMAS S.A.U.



	Contact Person 2: Name : Sergio De Campos Email : sdecampos@adasasistemas.com Institution : ADASA SISTEMAS S.A.U.
<u>Project Summary</u>  The main aim of the project is to promote the use and encourage the use and the market penetration of aquaTest-MO product, a new water quality monitoring and control product for WWTPs based on an eco-innovative on-line monitoring of the effluent, resulting from a research project. The aquaTest-MO product allows WWTPs to run affordable on-line monitoring scheme of the process, deriving in higher quality of treated water (less time to detect problems, less time for solving problems), meaning an increased productivity of the whole system and a faster water quality control loop.	
Descriptive keywords:	Water monitoring, water quality
Project Website:	<a href="https://ec.europa.eu/environment/eco-innovation/projects/en/projects/wwqm">https://ec.europa.eu/environment/eco-innovation/projects/en/projects/wwqm</a>
<u>Key Deliverables/Publications and Links</u>	

## Action C.11: Exploitation of deep saline aquifers

### Brief Description of the Concrete Action

The sole beneficiary for this action is the Energy and Water Agency which shall be responsible for the overall coordination and implementation of the action. The Water Services Corporation shall provide the necessary technical support as required.

The objective of this action is to develop a pilot abstraction, treatment and discharge system to enable the exploitation of deep saline groundwater. The implementation of this action is dependent on the deliverable of preparatory action A.9, since prior to the actual realisation of the pilot facility, the system shall be first tested by means of a numerical groundwater model to determine the impacts of varying abstraction rates on the fresh groundwater aquifer system.

Following the assessment of the results of the modelling exercise, a pilot experimental plant will be constructed at the fringes of the mean sea level aquifer system, and its operation analysed through the development of a dedicated *in situ* monitoring network. The technologies involved in the implementation of this action shall include the drilling of tightly cased deep sea-wells which traverse the freshwater aquifer system down to the saline aquifer, the installation of variable speed pumping equipment which is able to regulate abstraction rates based on water quality parameters and the setting up of a small desalination plant. These technologies already exist but have never been used conjunctively for the development of a pilot plant capable of abstracting and treating saline water from the deep aquifer system.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.11: Exploitation of deep saline aquifers
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Project Title:	Control of Seawater Intrusion through Injection-Extraction well system (Publication)
Project Acronym/ID:	Not Applicable
Project Duration:	1996 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: A. Mahesha Email: Not Available Institution: <u>National Institute of Technology Karnataka</u>
<u>Project Summary</u>  Control of seawater intrusion through a series of injection-extraction wells was studied using a vertically integrated, two-dimensional, sharp interface model. The model is based on the Galerkin weighted-residual technique and has been tested against the existing analytical solutions. The model is then cast in terms of the non-dimensional parameters, and a series of parametric studies are conducted to obtain the characteristic curves for the cases of a seawater extraction barrier alone and its combination with the freshwater injection barrier. These curves could be used to assess the effect of variations in the input parameters on the position of the seawater-freshwater interface toe position.	
Descriptive keywords:	'Coastal aquifers' 'Control seawater intrusion' 'Injection – extraction well system'
Project Website:	Not Applicable
<u>Key Deliverables/Publications and Links</u>  Mahesha, A. (1996). Control of Seawater Intrusion through Injection-Extraction Well System. <i>Journal of Irrigation and Drainage Engineering</i> , [online] 122(5), pp.314-317. Available at: <a href="https://www.researchgate.net/profile/A_Mahesha/publication/245288647_Control_of_Seawater_Intrusion_through_Injection-Extraction_Well_System/links/57063f3108aecbf68ba992bb/Control-of-Seawater-Intrusion-through-Injection-Extraction-Well-System.pdf">https://www.researchgate.net/profile/A_Mahesha/publication/245288647_Control_of_Seawater_Intrusion_through_Injection-Extraction_Well_System/links/57063f3108aecbf68ba992bb/Control-of-Seawater-Intrusion-through-Injection-Extraction-Well-System.pdf</a> [Accessed 31 Jan. 2018].	

Relevant LIFE IP Concrete Action:	Action C.11: Exploitation of deep saline aquifers
Project Title:	Saline water intrusion toward groundwater: Issues and its control (Scientific Article)
Project Acronym/ID:	Not Applicable
Project Duration:	2012 (Date Published)
Project Status:	Completed

Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Purnama S Email: setyapurna@geo.ugm.ac.id Institution: Faculty of Geography, Gadjah Mada University, Yogyakarta, Indonesia
<u>Project Summary</u>  <p>Nowadays, saline water pollution is increasingly becoming a major global issue, especially in urban coastal areas. Saline water pollution has major impact on human life and livelihood. It's mainly a result of static fossil water and the dynamics of sea water intrusion. The problem of saline water pollution caused by seawater intrusion has been increasing since the beginning of urban population. The problem of sea water intrusion in the urban coastal area must be anticipated as soon as possible especially in urban areas developed in coastal zones.</p> <p>In view of this, this review article aims to: (i) analyse the distribution of saline water pollution in the Semarang urban coastal area in Indonesia and (ii) analyse some methods in controlling saline water pollution, especially due to seawater intrusion in urban coastal areas. The strength and weakness of each method were analysed and compared. This analysis involved assessing the impacts that result from applying (a) different pumping patterns, (b) artificial recharge, (c) an extraction barrier, (d) an injection barrier and (e) a subsurface barrier. The best methods were selected on the basis of their possible development in coastal areas of developing countries. The results showed that artificial recharge and extraction barrier are the most applicable methods in the area.</p>	
Descriptive keywords:	'Groundwater' 'Saline water pollution' 'Seawater intrusion control'
Project Website:	Not Applicable
<u>Key Deliverables/Publications and Links</u>  <p>Purnama, S. and Aris Marfai, M. (2011). SALINE WATER POLLUTION IN GROUNDWATER: ISSUES AND ITS CONTROL. <i>Journal of Natural Resources and Development</i>. [online] Available at: <a href="http://jnrd.info/2012/10/10-5027jnrd-v2i0-06/">http://jnrd.info/2012/10/10-5027jnrd-v2i0-06/</a> [Accessed 31 Jan. 2018].</p>	

Relevant LIFE IP Concrete Action:	Action C.11: Exploitation of deep saline aquifers
Project Title:	Innovative Method for Saltwater Intrusion Control (Scientific Article)
Project Acronym/ID:	Not Applicable
Project Duration:	2014 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Z. Payal Email: Zpayal81@gmail.com

	Institution: Sarvajanik College of Engineering, Surat, India
<p><u>Project Summary</u></p> <p>Salt water intrusion is the migration of saltwater into freshwater aquifers under the influence of groundwater development (Freeze and Cherry, 1979). The most detrimental effect of ground water depletion is the lowering of the water table. Saltwater intrusion also has an adverse impact on the saltwater-freshwater interface. Methods for controlling intrusion vary widely depending on the source of the saline water, the extent of intrusion, local geology, water use and economic factors.</p> <p>The proposed methodology of this study was to control saltwater intrusion through (ADR) Abstraction, Desalination and Recharge. The proposed methodology takes into account the interactions between the major parameters of an ADR system to control saltwater intrusion. These parameters include: soil/aquifer properties, well locations, well depths, and abstraction and recharge rates. An additional major parameter is the relation between abstraction and recharge rates. However, this depends on the recovery rate (the rate at which freshwater is rising in a bore) and salinity (the concentration of dissolved salts in seawater) of the abstracted water.</p> <p>An ADR system is capable of completely preventing saltwater intrusion because it increases the volume of fresh groundwater and decreases the volume of saltwater, while considering economical aspects, environmental impact and sustainable development of water resources.</p>	
Descriptive keywords:	'Salt water intrusion' 'ADR methodology' 'Biscayne aquifer'
Project Website:	Not Applicable
<p><u>Key Deliverables/Publications and Links</u></p> <p>Payal, Z. (2014). Innovative Method for Saltwater Intrusion Control. <i>INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES &amp; RESEARCH TECHNOLOGY</i>, [online] 3(2). Available at: <a href="http://www.ijesrt.com/issues%20pdf%20file/Archives-2014/February-2014/65.pdf">http://www.ijesrt.com/issues%20pdf%20file/Archives-2014/February-2014/65.pdf</a> [Accessed 31 Jan. 2018].</p>	

Relevant LIFE IP Concrete Action:	Action C.11: Exploitation of deep saline aquifers
Project Title:	Numerical modelling and control of seawater intrusion in coastal aquifers (Conference paper)
Project Acronym/ID:	Not Applicable
Project Duration:	2013 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Javadi A.A Email: <a href="mailto:A.A.Javadi@exeter.ac.uk">A.A.Javadi@exeter.ac.uk</a> Institution: University of Exeter

	<p>Contact Person 2: Name: Hussain M.S Email: Not Available Institution: University of Exeter</p> <p>Contact Person 3: Name: Abd-Elhamid H.F. Email: Not Available Institution: Zagazig University</p> <p>Contact Person 4: Name: Sherif M.M. Email: Not Available Institution: United Arab Emirates University</p>
<p><u>Project Summary</u></p> <p>This paper studies the control of seawater intrusion using numerical modelling. A coupled transient density-dependent finite element model was used for modelling seawater intrusion. Also, a new cost-effective method for effectively controlling seawater intrusion in coastal aquifers was presented. This methodology (ADR -Abstraction, Desalination and Recharge) involves abstracting saline water and subsequently desalinating it. This desalinated water is then used for domestic consumption while any excess desalinated water is recharged to the aquifer.</p> <p>The numerical model was integrated with a genetic algorithm (GA) to simulate different scenarios to control seawater intrusion. The effects that different combinations of abstraction, desalination and recharge have on seawater intrusion were also simulated.</p> <p>The main objectives of the model were to minimise: the total capital and operational costs of the abstraction and recharge wells and the salt concentrations in the aquifer.</p> <p>The results showed that the proposed ADR system performs significantly better than using abstraction or recharge wells alone, as it is the least costly and results in lower salt concentrations in aquifers. From the study, it was found that the cost of the ADR system is about 50% of the abstraction only scenario and 25% of the recharge scenario. This is because the water needed for recharge is provided primarily from the treatment of abstracted saline water. Moreover, excess treated water can be directly used for other purposes. The other aspect of the system's efficiency is about minimising the total concentration of salinity in the aquifer as it has reduced the total concentration in the system by 15%. This is due to the system's capability of moving the aquifer transition zone further to the coast.</p>	
Descriptive keywords:	'Numerical modelling' 'Seawater intrusion' 'Optimal management' 'Abstraction' 'Recharge'
Project Website:	Not Applicable
<p><u>Key Deliverables/Publications and Links</u></p> <p>Numerical modelling and control of seawater intrusion in coastal aquifers. (2013). In: <i>18th International Conference on Soil Mechanics and Geotechnical Engineering</i>. [online] Available at: <a href="https://pdfs.semanticscholar.org/db85/1041116c39b47a614b8036af9c553118d13b.pdf">https://pdfs.semanticscholar.org/db85/1041116c39b47a614b8036af9c553118d13b.pdf</a> [Accessed 1 Feb. 2018].</p>	

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Relevant LIFE IP Concrete Action:	Action C.11: Exploitation of deep saline aquifers
Project Title:	Wellfield Design for a Reverse Osmosis Plant located over a Fresh Water Lens in Lower Valley, Grand Cayman, Cayman Islands (Scientific Article)
Project Acronym/ID:	Not Applicable
Project Duration:	Undated
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: Brian Jones Email: <a href="mailto:brian.jones@ualberta.ca">brian.jones@ualberta.ca</a> Institution: University of Alberta, Edmonton, Canada

#### Project Summary

This article showcases the challenges faced in the Cayman Islands for the design and installation of a well-field in an aquifer, while preventing the degradation a freshwater lens. In the Cayman Islands, it is typical to abstract the saline water needed for reverse osmosis plants from deep wells and dispose brines into zones that are deeper than the location zones.

In this particular case, the low porosity cap rock of the Cayman Formation isolated effectively the freshwater lens from water circulation in the deeper part of the succession. The well-field abstracted saline water from an open zone below the cap rock of the Cayman Formation at a depth of 45–65 m, and disposed brine at a depth of 62–86 m, where the bottom of the brine disposal zone is highly cavernous.

The plant became operational in 1998, and production capacity was doubled in 1999. The Lower Valley reverse osmosis plant has been operating successfully without adverse effects on the Lower Valley freshwater lens. This is evident by water quality data obtained from a network of monitoring wells designed to monitor the effects of the plant on the freshwater lens.

Descriptive keywords:	'Well-field design' 'Freshwater lens' 'Groundwater monitoring' 'Reverse osmosis'
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Project Website:	Not Applicable
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#### Key Deliverables/Publications and Links

Jones, B., van Genderen, H. and van Zanten, T. (n.d.). Wellfield Design for a Reverse Osmosis Plant located over a Fresh Water Lens in Lower Valley, Grand Cayman, Cayman Islands. [online]  
Available at:

[http://www.waterauthority.ky/upimages/publications/WellfieldDesignforaReverseOsmosisPlantlocatedoveraFreshWaterLensinLowerValley,GrandCayman,CaymanIslands.CWWA2001\\_1423218233.pdf](http://www.waterauthority.ky/upimages/publications/WellfieldDesignforaReverseOsmosisPlantlocatedoveraFreshWaterLensinLowerValley,GrandCayman,CaymanIslands.CWWA2001_1423218233.pdf) [Accessed 7 Feb. 2018].

## Action C.12: Heating and cooling installations

### Brief Description of the Concrete Action

The sole beneficiary for this action is the Energy and Water Agency who shall be responsible for the overall coordination and implementation of the action.

This action shall develop a closed loop heating and cooling pilot system to enable the assessment of the impact of the plant's operation on a coastal aquifer system. With the increasing focus on energy efficiency the use of the subsurface for heating and cooling applications is increasingly being considered as a potential solution to increase the energy efficiency of this process. However, whilst from an energy efficiency perspective, the application of this technology could support the achievement of national targets under the Renewable Energy and Energy Efficiency Directives; the discharge of heat to the subsurface under the Groundwater Directive is potentially considered as a 'pollutant discharge'. Furthermore, in a coastal environment, the discharge of heat can potentially induce convection currents which could facilitate the ingress of saline waters in the fresh groundwater lens.

The development of a heating and cooling system at a pilot level is being proposed under this action to enable the testing of these systems under controlled conditions. The pilot plant shall be located at the fringe regions of the aquifer system, to minimise any potential risks resulting from its operation. Whilst the application of such systems is already an established practice in large aquifer systems, their application in small, coastal aquifer systems, which are prone to vertical sea-water intrusion, has to date been quite limited.

The impact arising from the operation of the heating and cooling system shall initially be assessed through the use of a groundwater numerical model (discharge of heat) and eventually also assessed through the development of dedicated groundwater monitoring network focused on the monitoring of temperature and salinity in the immediate area around the heating and cooling system.

Through this pilot initiative, the action will also attempt to develop a safe application framework for such systems, given the expected future demand for the establishment of such systems in view of increasing obligations in terms of energy efficiency and the application of alternative energy management practices.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.12: Heating and cooling installations
Project Title:	Seasonal storage of residual heat from a combined heat and power installation in an aquifer on the site of the university
Project Acronym/ID:	EC./00367/86
Project Duration:	01-11-1987 to 01-01-1993

Project Status:	Completed
Funding Programme:	ENG-ENDEMO C
Key Contacts:	Contact Person 1: Name: MEULENKAMP A. C. M. Email/Telephone: +31-340598500 Institution: BREDERO ENERGY SYSTEM BV
<u>Project Summary</u>  <p>This project was an innovative system for the storage of residual heat in an aquifer at the University of Utrecht. By using heat storage, the number of operating hours of the heat and power installations during the summer period was increased as the heat produced was usefully employed. The stored heat was used during winter for space heating. As a consequence, less gas had to be used for space heating during the winter months and during summer less electricity had to be purchased. The degree of utilisation of the heat and power installations was increased, while the primary energy consumption was reduced.</p> <p>The aim of the project was to demonstrate a practical applicability of heat storage in aquifers, in combination with combined heat and power installations in order to augment the useful exploitation of these installations. These installations were regulated on the basis of the heat requirements of the buildings of the university complex, which meant that at a reduced heat demand during summer, the installations were run at part load to avoid unprofitable production of excess heat. This led to a lower total yield of the heat and power installations and additional electricity also had to be purchased. As a result, residual heat in the form of water at a temperature of 90°C was stored in an aquifer and then used to produce electricity, which was used by the university complex. The stored residual heat was used in winter for the heating of a few buildings of the complex. In the feasibility study it was estimated that a thermal result (the heat stored which was then retrieved) of about 65% to 75% in the third year was achieved. At the realisation of the heat storage, additional data of the soil structure was obtained, thus soil structure could be represented better diagrammatically.</p>	
Descriptive keywords:	'Aquifer' 'Seasonal thermal energy storage'
Project Website:	<a href="http://cordis.europa.eu/project/rcn/15128_en.html">http://cordis.europa.eu/project/rcn/15128_en.html</a>
<u>Key Deliverables/Publications and Links</u>	

Relevant LIFE IP Concrete Action:	Action C.12: Heating and cooling installations
Project Title:	Seasonal storage of heat and cold in an aquifer for cooling and pre-heating ventilation supply air in a hospital
Project Acronym/ID:	BU./00387/91
Project Duration:	14-10-1991 to 01-08-1994
Project Status:	Completed
Funding Programme:	ENG-THERMIE 1
Key Contacts:	Contact Person 1:



	Name: BUITENHUIS J. J Email/Telephone: +31-182066666 Institution: GROENE HART ZIENKENHUIS
<p><u>Project Summary</u></p> <p>In this project, the extension of the existing cooling capacity was realised with an Aquifer Thermal Energy Storage (ATES) instead of a conventional chiller. Compared with a chiller, the use of ATES reduced the electricity consumption for cooling by 50%. Moreover, the heat that was extracted from the ventilation supply air in summer was stored in the aquifer to be utilised in winter for (pre)heating ventilation air. The integration of the ATES system in the installation with 2 chillers enabled also short-term cold storage in summer. Therefore, the risk of cold shortage due to climatic influences (warm summer and/or mild winter), was compensated for without costly investments in extra chiller capacity. Furthermore, the combined use of the aquifer system for seasonal cold and heat storage, as well as short-term cold storage made the system more profitable. Consequently ATES can also be attractive for smaller projects with existing cooling systems that have to be extended. Therefore, this will enlarge the market potential for ATES. For instance, in the first half of summer 1994 (April, May, June and July) the storage delivered 256 MWhth (megawatt hours of heat) cold and 82,000 kWhe (kilowatt hours of electricity) were saved. No additional cooling was applied thanks to the lower temperature in the cold storage.</p> <p>The project demonstrated:</p> <ul style="list-style-type: none"> <li>• That the required extension of the cooling capacity in the hospital can be realised by storage or "winter cold" in a sand-layer (aquifer) in the soil, and that such a storage system can be integrated in the existing cooling system.</li> <li>• The technical and economical feasibility of combined seasonal cold and heat storage in an aquifer for cooling and (pre)heating ventilation supply air.</li> <li>• And the advantages of using the aquifer for short time storage of cold that is loaded at night with the available chillers, thus creating extra facilities for energy management and compensating for risks of cold shortage due to climatic influences.</li> </ul>	
Descriptive keywords:	'Aquifer thermal energy storage'
Project Website:	<a href="http://cordis.europa.eu/project/rcn/22199_en.html">http://cordis.europa.eu/project/rcn/22199_en.html</a>
<u>Key Deliverables/Publications and Links</u>	

Relevant LIFE IP Concrete Action:	Action C.12: Heating and cooling installations
Project Title:	Limestone aquifer thermal energy storage as a heat source for heat pump
Project Acronym/ID:	EC./00509/86
Project Duration:	01-11-1987 to 31-10-1989
Project Status:	Completed
Funding Programme:	ENG-ENDEMO C

Key Contacts:	Contact Person 1: Name: SORENSEN N. Email/Telephone: +45-2859222 Institution: NIELSEN & RAUSCHENBERGER
<u>Project Summary</u>  The aims of this project were: <ul style="list-style-type: none"> <li>To obtain practical experience from the establishment and operation of a low temperature heat storage system in a limestone aquifer, in connection with a district heating system; and</li> <li>To demonstrate the possibilities of commercial use of this type of aquifer in heating systems in combination with heat pumps.</li> </ul> <p>The waste heat from a nuclear research reactor was used as a heat source for a 2.2 MW heat pump that was connected to a district heating system. The temperature of this waste heat was between 40°C and 45°C. However during normal operation, approximately three times as much waste heat was available as it could have been utilised by the heat pump. The nuclear reactor used to close down for 5 days every 4 weeks and during this period heat was being supplied by the combustion of oil. The idea was to store surplus heat from the reactor in a limestone aquifer and extract this heat during periods of reactor shutdown. Two main wells 100 metres apart were used, one for injection of the heated water, and the other one for extraction. The extracted water was expected to be at a temperature of around 30 °C. Two further wells were drilled for measurement purposes and equipped with temperature and pressure transducers that were connected to a computer system.</p>	
Descriptive keywords:	‘Aquifer thermal energy storage’
Project Website:	<a href="http://cordis.europa.eu/project/rcn/15131_en.html">http://cordis.europa.eu/project/rcn/15131_en.html</a>
<u>Key Deliverables/Publications and Links</u>	

Relevant LIFE IP Concrete Action:	Action C.12: Heating and cooling installations
Project Title:	Inter-seasonal solar heat storage in phreatic water table for space heating in a school
Project Acronym/ID:	SE./00240/83
Project Duration:	01-07-1984 to 01-09-1987
Project Status:	Completed
Funding Programme:	ENG-ENALT 2C
Key Contacts:	Contact Person 1: Name: JULLIENNE Email/Telephone: +33-30438104 Institution: SAAN
<u>Project Summary</u>  The project’s aim was to demonstrate how a school of 16 classrooms (7,500 m <sup>3</sup> ) can be heated from solar energy which is stored in an aquifer (aquifer des sables de Fontainebleu) during summer and	

is extracted by an intermediary heat pump in winter. Apart from showing that the energy collected in summer can be used in winter, the optimum system management was investigated. The process could have been reproduced using an industrial waste heat source, if successful. It was expected that about 200 MWh could be extracted from the aquifer giving a payback of 18 years.

Bearing in mind the intermittent use of the classrooms, the most appropriate form of heating appeared to be pulsed air. Since a certain level of ventilation is necessary, a static recuperator was used to recover heat from the exhausted air. Total heat requirements were 260 MWh per year of which 55 were furnished by the recuperator. The remaining, were extracted from the hot water store in the Fontainebleau sands, which is found beneath the school. This storage was charged during summer. Solar panels, functioning as a cold source for a heat pump, supplied heat to the underground "nappe"; water was extracted by way of a "cold" well and its temperature increased from 12°C (first year) to 50°C by passing through the heatpump's condensor before being re-injected into the nappe through the hot well. The heat pump allowed the reinjection temperature to be maintained at a constant level thereby guaranteeing higher efficiency. In winter, the warm water was pumped out and heat was transferred to air. The storage was dimensioned to cover all the needs of an average year, however if the temperature of the nappe is too low the water can be used as the cold source of the heat exchanger.

Descriptive keywords:	'Aquifer' 'Thermal energy' 'Seasonal storage'
Project Website:	<a href="http://cordis.europa.eu/project/rcn/18685_en.html">http://cordis.europa.eu/project/rcn/18685_en.html</a>
<u>Key Deliverables/Publications and Links</u>	

Relevant LIFE IP Concrete Action:	Action C.12: Heating and cooling installations
Project Title:	Solar energy and aquifer storage for office building space heating
Project Acronym/ID:	SE./00418/83
Project Duration:	30-08-1983 to 30-05-1987
Project Status:	Completed
Funding Programme:	ENG-ENALT 2C
Key Contacts:	Contact Person 1: Name: GROENEVELD G. J. Email/Telephone: +31-85778899 Institution: HEIDEMIJ ADVIESBUREAU
<u>Project Summary</u>	
<p>The project aim was to demonstrate that space heating by means of solar energy and aquifer storage is technically feasible and capable of primary energy savings +/- 50%. The project was built in Bunnik for the company Bredero. The office building to be heated consisted in three units of 9,000 m<sup>2</sup> total floor surface with an annual heat demand of 660 MWh. The building was not equipped with a cooling system except for the computer room.</p> <p>The heating system contained: flat plate solar collectors, short term energy storage, long term</p>	

thermal energy aquifer storage (with an estimated injection and extraction of about 18,000 m<sup>3</sup>), a gas engine driven heat pump and a conventional gas boiler. For space heating, the waste heat of the computer room cooling system was used (95 MWh/yr). The annual gas consumption of the heating system was estimated to be 392 MWh. There were three operating modes of the plant:

Summer: heat from the collectors and the computer cooling system is injected into the Aquifer

Spring/Autumn: space heating by a heat pump with heat supply from solar collectors and cooling system waste heat

Winter: space heating by heat pumps with heat supply from an aquifer and a cooling system and additional heating by a gas boiler at low outside temperatures. The solar system is not in operation in the wintertime.

Descriptive keywords:	'Aquifer thermal energy storage' 'Heating'
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Project Website:	<a href="http://cordis.europa.eu/project/rcn/18681_en.html">http://cordis.europa.eu/project/rcn/18681_en.html</a>
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Key Deliverables/Publications and Links

Relevant LIFE IP Concrete Action:	Action C.12: Heating and cooling installations
Project Title:	Heating and cooling of a hospital using solar energy coupled with seasonal thermal energy storage in an aquifer (Scientific Paper)
Project Acronym/ID:	Not Applicable
Project Duration:	2000 (Year published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: H.O. Paksoy Email: <a href="mailto:hopaksoy@cu.edu.tr">hopaksoy@cu.edu.tr</a> Institution: University of Cukurova, Faculty of Arts and Sciences, Adana, Turkey
<u>Project Summary</u>	
In the year 2000, a system that uses solar energy in combination with Aquifer Thermal Energy Storage (ATES) was being designed. Its aim was to conserve a major part of the oil and electricity used for heating or cooling the Cukurova University, Balcali Hospital in Adana, Turkey. The general objective of the system was to provide heating and cooling to the hospital by storing solar heat underground in summer and cold in winter. As the main source of cold energy, ventilation air at the hospital and surface water from the nearby Seyhan Lake was to be used.	
Descriptive keywords:	'Aquifer thermal energy storage' 'Energy conservation'

Project Website:	Not Applicable
<u>Key Deliverables/Publications and Links</u>  Paksoy, H., Andersson, O., Abaci, S., Evliya, H. and Turgut, B. (2000). Heating and cooling of a hospital using solar energy coupled with seasonal thermal energy storage in an aquifer. <i>Renewable Energy</i> , 19(1-2), pp.117-122.	

Relevant LIFE IP Concrete Action:	Action C.12: Heating and cooling installations
Project Title:	Aquifer Thermal Energy Storage Application in Greenhouse Climatization (Scientific paper)
Project Acronym/ID:	Not Applicable
Project Duration:	2009 (Date published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Contact Person 1: Name: H.O. Paksoy Email: <a href="mailto:hopaksoy@cu.edu.tr">hopaksoy@cu.edu.tr</a> Institution: University of Cukurova, Faculty of Arts and Sciences, Adana, Turkey

#### Project Summary

This research project aimed to determine the heating and cooling potential of aquifer thermal energy storage (ATES) systems in the Mediterranean climatic zone. The project was carried out in greenhouses at the Cukurova University, Adana, during 2005-2006. For this purpose, two plastic greenhouses, each having an area of 360 m<sup>2</sup>, were used. One of them was heated and cooled by an ATES system. In the second one, conventional heating and cooling systems were used. The inside and outside temperatures of the greenhouses, as well as ground water and exchanger water temperatures were recorded throughout the experimental period. Tomato crop was grown in both greenhouses and plant growth and fruit yield were measured. Energy costs of the greenhouses (fuel oil for the conventionally heated greenhouse and electricity for the ATES system) were also calculated. Consequently, these two systems were technically and economically compared.

The collected data showed that ATES systems have good potential for climatisation, both for heating and cooling, of greenhouses in the Mediterranean climatic zone. Between October 20<sup>th</sup> and April 10<sup>th</sup>, the inside temperature of the ATES system heated greenhouse was never below critical level (120 °C) and thanks to this performance, the ATES greenhouse never used any fuel oil. On the other hand, temperature fluctuations in the ATES greenhouse were less than the conventionally heated one. The energy cost saving with ATES for heating was about 70% in comparison with the conventionally heated (with fuel-oil) greenhouse. With respect to tomato yield, the greenhouse that was heated by the ATES system resulted in approximately 20% more yield than that in the conventionally climatised one.

Descriptive keywords:	'Cooling' 'Heating' Tomato' 'Plant growth' 'Yield'
Project Website:	Not Applicable
<u>Key Deliverables/Publications and Links</u>  Turgut, B., Dasgan, H., Abak, K., Paksoy, H., Evliya, H. and Bozdag, S. (2009). Aquifer thermal energy storage application in greenhouse climatization. Acta Horticulturae, (807), pp.143-148.	

## Action C.13: Restoration of one of the coastal wetlands

### Brief Description of the Concrete Action

This action will involve the restoration of one of "Il-Ballut ta' Marsaxlokk", which is one of the coastal wetlands on the Maltese Islands which is designated as a Special Area of Conservation as part of the Natura 2000 network in line with the requirements of the Habitats Directive (92/43/EEC). The Environment and Resources Authority is responsible for the designation and management of Natura 2000 sites and will thus be in charge of coordinating the implementation of this action.

"Il-Ballut ta' Marsaxlokk" is one of the few remaining coastal wetlands in the Maltese Islands, and despite its highly modified nature due to past anthropogenic interventions, it constitutes an important habitat owing to the presence of a seasonal watercourse bringing fresh water into the marsh. This wetland harbours plant communities which show a remarkable difference to those found in the northern part of the island, suggesting a restricted distribution of the biota found at "Il-Ballut ta' Marsaxlokk". In view of its ecological importance, the wetland has been designated as an inland surface water body for the purpose of the EU Water Framework Directive (WFD).

The status of this wetland has been defined in the management plans drawn up for Natura 2000 sites on the Maltese Islands and the communities present are not deemed to be in favourable conservations status in view of the restricted space occupied by the wetland. Attempts to assess the WFD Biological Quality Elements for this wetland as a transitional water body resulted in varying ecological status across seasons, mainly as a result of the complex ecological assemblages influenced by periodical evaporation of the water body and levels of salinity. Coastal erosion is considered to be the main pressure on this coastal wetland since this may result in further reduction of the area occupied by the wetland.

This action will seek the restoration of this coastal wetland through the required studies and elaboration and implementation of targeted plans. This restoration process will involve the following actions:

- 1) An assessment of the status of the hydrological regime within the marshland with a view to identify alternative solutions to re-establish the natural hydrological regime, including an investigation for the utilisation of adjacent land.
- 2) A technical study on the coastal erosion processes affecting the coastal wetland including the assessment of the effects of restoration efforts (if any) and the identification of further required interventions.
- 3) The development and implementation of an alien plant eradication programme.
- 4) The development and implementation of a visitor management plan.

- 5) Implementation of the technical works specified by the studies on: (i) coastal erosion control (ii) on the re-establishment of the natural hydrological regime and (iii) other necessary restoration and management interventions.
- 6) The development and implementation of detailed monitoring programmes for listed habitats and water quality; identification of further restoration requirements on the basis of monitoring data.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	C.13: Restoration of one of the coastal wetlands
Project Title:	Satellite-based Wetland Observation Service
Project Acronym/ID:	SWOS/ 642088
Project Duration:	2015-2018
Project Status:	Ongoing
Funding Programme:	Horizon 2020: H2020-SC5-2014-two-stage
Key Contacts:	Contact Person 1: Name: JENA-OPTRONIK GMBH Email: info@jena-optronik.de Institution: <b>Jena-Optronik, Germany</b>
<p><u>Project Summary</u></p> <p>The objective of the project SWOS is to develop a monitoring and information service focussing on wetland ecosystems. Globally, wetlands are the ecosystems with the highest rate of loss. This is alarming, considering their significance as biodiversity hotspots and ecosystems with a central role in the water cycle, including improving water quality and reducing water scarcity, in climate regulation and the economic benefit gained from using their services. A key limitation to their more effective conservation, sustainable management and restoration is the missing knowledge underpinning the consideration of wetlands in the implementation of key policy areas. Under the Biodiversity Strategy, Member States in Europe have committed to the mapping and assessment of ecosystem services (MAES); this provides a key instrument for an improved integration of wetlands in European policy.</p> <p>SWOS is taking full advantage of the new and freely available data from the Sentinel satellites and integrating results from the ESA Globwetland and other projects. Production of maps and indicators, based on historical and current observations allows the assessment of biodiversity and monitoring of dynamic changes in an unmatched temporal and spatial resolution.</p> <p>The SWOS Portal provides a unique entry point to locate, access and connect existing information. The SWOS Software toolbox GEOclassifier is an easy to use software toolbox to prepare maps and calculate indicators. With its Portal and toolbox SWOS contributes to establishing a Global Wetland Observing System (GWOS) (requested by Ramsar) by delivering the initial infrastructure.</p> <p>User organisations working at all levels from local to global belong to the SWOS project team and build, together with external user organisations, the key user group of SWOS. User needs were</p>	

captured through user requirements questionnaires and follow-up discussions and translated into technical requirements for the definition of SWOS products (maps and indicators). The services that SWOS provides facilitate local and EU monitoring tasks and support international reporting obligations. SWOS positions Europe in a leading role within GEO, in particular via the new GEO-Wetlands initiative. SWOS took a leading role from the beginning and is the main contributor. The Service Cases, developed in SWOS, put the SWOS into practice, test and validate the service and demonstrate how to use and benefit from it. The direct involvement of users ensures the usability and acceptance of the service, including harmonization with related activities, which provides a long-term impact.

Descriptive keywords:	Earth observations; ecosystems; modelling; wetlands
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Project Website:	<a href="http://swos-service.eu/">http://swos-service.eu/</a>
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#### Key Deliverables/Publications and Links

Newsletter 1: <http://swos-service.eu/2016/10/04/newsletter-1/>

Newsletter 2: <http://swos-service.eu/2017/02/07/swos-newsletter-2-improving-wetlands-monitoring-assessment/>

Newsletter 3: <http://swos-service.eu/2017/09/27/swos-newsletter-3/>

Newsletter 4: <http://swos-service.eu/2018/04/05/swos-newsletter-4/>

Guidelines for the delimitation of wetland ecosystems: [http://swos-service.eu/wp-content/uploads/2016/06/SWOS\\_Wetlands-delimitation-guidelines\\_FINAL\\_v1.1.pdf](http://swos-service.eu/wp-content/uploads/2016/06/SWOS_Wetlands-delimitation-guidelines_FINAL_v1.1.pdf)

The wetland ecosystems in MAES nomenclature: [http://swos-service.eu/wp-content/uploads/2017/05/SWOS\\_MAES-wetland-component-v1.2.pdf](http://swos-service.eu/wp-content/uploads/2017/05/SWOS_MAES-wetland-component-v1.2.pdf)

MAES Service Case: Wetland ecosystem condition mapping: [http://swos-service.eu/wp-content/uploads/2017/06/MAES\\_WetlandEcosystemCondition\\_v1.01.pdf](http://swos-service.eu/wp-content/uploads/2017/06/MAES_WetlandEcosystemCondition_v1.01.pdf)

Relevant LIFE IP Concrete Action:	C.13: Restoration of one of the coastal wetlands
Project Title:	REFRESH (Adaptive Strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems)
Project Acronym/ID:	REFRESH/ 244121
Project Duration:	2009-2014



Project Status:	Completed
Funding Programme:	FP7-ENVIRONMENT
Key Contacts:	Contact Person 1: Name: Dr. Martin Kernan Email: m.kernan:@ucl.ac.uk Institution: University College London
<p><u>Project Summary</u></p> <p>The project 'Adaptive strategies to mitigate the impacts of climate change on European freshwater ecosystems' (REFRESH) had three overarching goals. The first was to increase understanding of how freshwater ecosystems will respond to changes caused by climate, land use, water use and pollution over the next 50-60 years. Additional goals involved translating this knowledge into a form that can be used by water managers and ensuring the uptake of results by target stakeholders.</p> <p>Consortium members focused on three principal climate-related and interacting pressures: increasing temperature, changes in water levels and flow regimes, and excess nutrients. The work was conducted primarily in lowland rivers, lakes and wetlands as they often pose the greatest challenges in complying with the requirements of the Water Framework Directive (WFD) and Habitats Directive.</p> <p>Studies of streams provided a basis for applying knowledge on the effects of climate change and land-use change on the structure, functioning and biodiversity in rivers. They also provided insights into the effectiveness of adaption and mitigation methods to restore rivers.</p> <p>Scientists found that shading beside streams can help offset the impact of increased temperature and influence stream biodiversity. Increased winter flooding was found to have a longer-term effect on river vegetation. A new method was also devised for calculating net primary production from midday oxygen saturation.</p> <p>Stagnation and drought experiments provided insights into the role of low flow and drought in rivers and potential losses to the ecosystem. The experiments provided thresholds for low flow and drought in Atlantic lowland rivers. River flow and oxygen appeared vital for rivers and affect the functioning of the ecosystem.</p> <p>Good oxygen regimes and healthy flow conditions help ensure the objectives of the EU's WFD and Habitats Directive are met. Therefore, specific adaptive measures were evaluated and used to minimise the expected adverse effects of climate change on freshwater quantity, quality and biodiversity.</p> <p>The work carried out by REFRESH will improve understanding of freshwater ecosystems. This will enable them to be restored to good ecological health, support key species and mitigate the effects of climate variation. REFRESH will therefore help safeguard Europe's freshwater ecosystems from the impacts of climate change.</p>	
Descriptive keywords:	Climate change; ecosystems; freshwater quality; freshwater quantity
Project Website:	<a href="http://www.refresh.ucl.ac.uk/about/background">http://www.refresh.ucl.ac.uk/about/background</a>

Key Deliverables/Publications and Links

Project final report: <https://cordis.europa.eu/docs/results/244/244121/final1-refresh-final-report-m1-m48.pdf>

Refresh publications (136 papers): <http://www.refresh.ucl.ac.uk/biblio>

Refresh deliverables: <http://www.refresh.ucl.ac.uk/DeliverablesTable>

Relevant LIFE IP Concrete Action:	C.13: Restoration of one of the coastal wetlands
Project Title:	Enhancing the role of wetlands in integrated water resources management for twinned river basins in EU, Africa and South-America in support of EU water initiatives
Project Acronym/ID:	WETWIN/ 212300
Project Duration:	2008-2011
Project Status:	Completed
Funding Programme:	FP7-ENVIRONMENT
Key Contacts:	<p>Contact Person 1:  Name: Dr. István Zsuffa and Jan Cools  Email: - <a href="mailto:istvan.zsuffa@vituki.hu">istvan.zsuffa@vituki.hu</a> and <a href="mailto:jan.cools@soresma.be">jan.cools@soresma.be</a>  Institution: VITUKI (Hungary), SORESMA (Belgium), PIK (Germany), WKL (Austria), UNESCO-IHE (The Netherlands), WI (Mali), NWSC (Uganda), IWMI (South Africa), ESPOL (Ecuador)</p>

Project Summary

The WETWIN approach for stopping and reversing the ongoing degradation of wetlands was based on the four basic premises of wetland management: wise use, adaptive management, integrated water resource management, and participation of local communities and stakeholders. Seven wetlands were investigated from Africa, Europe and South America.

WETWIN researchers identified a range of problems at the case study sites. These included desiccation and terrestrialisation due to reduced inflows, encroachment and disturbance, pollution and diseases like malaria from mosquito vectors in the tropical wetland habitat. Moreover, the high nutrient content of these wastewaters, plus the nutrient-rich runoff waters coming from the agricultural lands result in eutrophication problems.

Involvement of stakeholders from the case study sites played a crucial role in the project throughout. The WETWIN project applied an ecosystem services approach for characterisation of the natural and socioeconomic statuses of wetlands. Characterisation was followed by the

identification of major environmental and livelihood issues/problems at the wetlands. Cause–effect mechanisms behind the problems were explored with the help of the driving-forces, state, impact and responses (DSIR) methodology.

WETWIN researchers were particularly concerned about reducing vulnerability in the wetlands in terms of external impact (EI) and adaptive capacity (AC). Their aim was to apply appropriate management interventions on a local to large scale. These actions could turn the state of the wetlands, and also that of the basin, from vulnerable to resilient.

Wetlands International is a non-profit organisation for conservation of wetlands. They aim to organise several dissemination activities that may include WETWIN factsheets in French, training materials and guidelines, and a brochure on health impact. Further development of a sophisticated model system for the Inner Niger Delta (IND) leading to a high-resolution digital terrain model is also planned.

The outcomes of WETWIN are expected to enhance the recognition of the functions and services that wetland ecosystems provide on local and on river basin scales. The alarming messages of the project about the degradation and vulnerability of wetlands will help to raise awareness in politicians, managers and stakeholders. These interventions will bring conservation, restoration and sustainable management of wetlands more into the limelight.

Descriptive keywords:	Functions; services; wetland; ecosystems; awareness
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Project Website:	<a href="http://www.wetwin.net">www.wetwin.net</a> (currently broken link)
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#### Key Deliverables/Publications and Links

WETWIN leaflet: [http://www.wetwin.eu/downloads/130109\\_WETwin\\_leaflet\\_final\\_v3.pdf](http://www.wetwin.eu/downloads/130109_WETwin_leaflet_final_v3.pdf)

Open Access publications:

Ecological niche models for the evaluation of management options in an urban floodplain—conservation vs. restoration purposes

<https://www.sciencedirect.com/science/article/pii/S146290111200144X?via%3Dihub>

Quantifying ecosystem service trade-offs: The case of an urban floodplain in Vienna, Austria

<https://www.sciencedirect.com/science/article/pii/S0301479712003118?via%3Dihub>

Relevant LIFE IP Concrete Action:	C.13: Restoration of one of the coastal wetlands
Project Title:	Operationalisation of natural capital and ecosystem services: from concepts to real-world applications
Project Acronym/ID:	OPENNESS/ 308428

Project Duration:	2012-2017
Project Status:	Completed
Funding Programme:	FP7-ENVIRONMENT
Key Contacts:	Contact Person 1: Name: Prof Eeva Furman Email: eeva.furman@ymparisto.fi Institution: Finnish Environment Institute

#### Project Summary

OpenNESS aims to translate the concepts of Natural Capital (NC) and Ecosystem Services (ES) into operational frameworks that provide tested, practical and tailored solutions for integrating ES into land, water and urban management and decision-making. It examines how the concepts link to, and support, wider EU economic, social and environmental policy initiatives and scrutinizes the potential and limitations of the concepts of ES and NC. OpenNESS works in close cooperation with decision makers and other stakeholders.

The specific aims of OpenNESS are:

- To advance conceptual understanding of ES and NC and provide operational frameworks for application of the concepts in real-world management and decision-making situations
- To examine how existing and forthcoming EU regulatory frameworks can enhance or restore the benefits derived from ES and NC using multi-scale scenario approaches
- To develop and refine approaches for mapping and modelling the biophysical control of ES that can be used to assess the effectiveness of mechanisms, instruments and best management practices for sustaining ES delivery in the face of multiple uncertain drivers whilst conserving biodiversity
- To develop hybrid methodologies that address trade-offs, synergies and conflicting interests and values in the use of ES through a combination of monetary, non-monetary and deliberative methods within multi-criteria and Bayesian approaches to decision support
- To apply the concepts and methods developed and refined in the project to concrete, place-based case studies in a range of social-ecological systems with stakeholders and analyse the implications of local, regional and EU level decisions on the ES flows and use in other parts of the world
- To translate the results into policy recommendations and integrate the outputs in a Menu of Multi-Scale Solutions and associated datasets that are available for ES users and managers as well as decision-makers
- To disseminate the results and to promote and maintain science-policy dialogue on the use of the concepts of ES and NC in sustainable land, water and urban management.

Descriptive keywords:	Functions; services; wetland; ecosystems; awareness
Project Website:	<a href="http://www.openness-project.eu/">http://www.openness-project.eu/</a>
<u>Key Deliverables/Publications and Links</u>	
OPENNESS Library: <a href="http://www.openness-project.eu/library">http://www.openness-project.eu/library</a>	
OPENNESS peer-reviewed articles: <a href="http://www.openness-project.eu/library/articles">http://www.openness-project.eu/library/articles</a>	
ECOSYSTEM SERVICES reference book: <a href="http://www.openness-project.eu/library/reference-book">http://www.openness-project.eu/library/reference-book</a>	
The OPENNESS glossary: <a href="http://www.openness-project.eu/sites/default/files/OpenNESS_Glossary_final.pdf">http://www.openness-project.eu/sites/default/files/OpenNESS_Glossary_final.pdf</a>	

Relevant LIFE IP Concrete Action:	C.13: Restoration of one of the coastal wetlands
Project Title:	Finding optimal size and location for wetland restoration sites for best nutrient removal performance using spatial analysis and modelling
Project Acronym/ID:	OPTWET/ 660391
Project Duration:	2015-2018
Project Status:	Completed
Funding Programme:	Horizon2020
Key Contacts:	Contact Person 1: Name: Evelyn Uemaa Email: <a href="mailto:evelyn.uemaa@ut.ee">evelyn.uemaa@ut.ee</a> Institution: Department of Geography, University of Tartu, 51014 Tartu, Estonia

Project Summary

Diffuse losses of nitrogen and phosphorus from agricultural areas contribute significantly to eutrophication of waterways, lakes, estuaries and coastal zones and water pollution is a growing and serious problem across much of the world. The role of wetlands in improving surface water quality is well known. The capacity of wetlands to improve water quality is dependent on a large number of parameters that have been widely studied, such as vegetation cover or type, water retention time, climatic variables, and also their size and spatial arrangement in the watershed. However, the question where wetlands should be located in agricultural catchments to achieve the most effective nutrient removal at the catchment level has not been clearly resolved.

This project aims to determine the optimal sizing and location for wetlands in agricultural catchments to reduce nutrient (nitrogen and phosphorus) loads in catchments. The study consists of two parts performed on study areas with different landscape and climatic conditions. Firstly, potentially suitable wetland restoration/creation sites are identified by using high quality data and geospatial analysis techniques. Secondly, evaluation of the effectiveness of wetland nitrogen and phosphorus removal from surface waters at various potential locations indicated by the geospatial analyses under different hydrological regimes and land use scenarios will be done by using modelling with CLUES (Catchment Land Use for Environmental Sustainability model) and SWAT (Soil and Water and Assessment Tool). Using and integrating different datasets and modelling approaches also plays an important role in the study.

Descriptive keywords:

nitrogen; phosphorous; wetlands; sustainability; and agriculture

Project Website:

<http://wetsci.blogspot.com/mt/>

#### Key Deliverables/Publications and Links

Uuemaa, E.; Palliser, C.; Hughes, A. Tanner, C.(2018). Effectiveness of a Natural Headwater Wetland for Reducing Agricultural Nitrogen Loads. *Water*, 10 (3), 1–17.w10030287.

Kmoch, A.; Uuemaa, E.; Klug, H.; Cameron, S. G.; (2018). Enhancing Location-Related Hydrogeological Knowledge. *ISPRS International Journal of Geo-Information*, 7 (132, 4).10.3390/ijgi7040132.

Pärn, J.; Henine, H.; Kasak, K.; Kauer, K.; Sohar, K.; Tournebize, J.; Uuemaa, E.; Välik, K.; Mander, Ü.; (2018). Nitrogen and phosphorus discharge from small agricultural catchments predicted from land use and hydroclimate. *Land Use Policy*, 75, 260–268.10.1016/j.landusepol.2018.03.048.

Uuemaa, E.; Hughes, O. A.; Tanner, C. C.; (2018). Identifying Feasible Locations for Wetland Creation or Restoration in Catchments by Suitability Modelling Using Light Detection and Ranging (LiDAR) Digital Elevation Model (DEM). *Water*, 10 (4), 1–15.w10040464.

Mõisja, K.; Oja, T.; Uuemaa, E.; Hastings, J. T. (2017). Completeness and classification correctness of features on topographic maps: An analysis of the Estonian basic map. *Transactions in GIS*, 30(5), 954-968, DOI:10.1111/tgis.12257

Aavik, T.; Talve, T.; Thetloff, M.; Uuemaa, E.; Oja, T. (2017). Genetic consequences of landscape change for rare endemic plants – A case study of *Rhinanthus osiliensis*. *Biological Conservation*, 210, 125–135, 10.1016/j.biocon.2017.04.016. 1.1.

Uuemaa E., Oja T. (2017) Mapping the Abstractions of Forest Landscape Patterns. In: Remmel T., Perera A. (eds) *Mapping Forest Landscape Patterns*. Springer, New York, NY, doi.org/10.1007/978-1-4939-7331-6\_6

Mõisja, K.; Uuemaa, E.; Oja T.(2016). Integrating small-scale landscape elements into land use/cover: The impact on landscape metrics' values. *Ecological Indicators*, 67, 714–722, 10.1016/j.ecolind.2016.03.033.

## Action C.14: Anchoring and Mooring Surveys

### Brief Description of the Concrete Action

The Environment and Resources Authority (ERA) will be in charge of coordinating the implementation of this action. They will also collaborate with other government entities, who would provide feedback throughout the implementation of this action.

Anchoring and mooring activity is generally associated with pressures on seabed habitat types through physical damage. While the impacts of such activities are widely known, this pressure has not been quantified on a national scale. There is very little information available on the extent of damage that mooring/anchoring of vessels is causing to seabed habitats. Within this context, there is a need to gauge the extent of anchoring/mooring activities in Maltese waters in order to better inform management regimes targeting the impacts which may arise through such activities.

This action will address this knowledge gap by surveying and mapping the marine waters which are subject to mooring/anchoring activity on the basis of seasonal surveys, aerial imagery and other data. This mapping exercise will be used to assess the intensity, type and spatio-temporal occurrence of anchoring/mooring activity in Maltese territorial waters. Such an assessment will distinguish between types of vessels in view of the fact that different types of vessels and associated anchoring activity would necessitate different management approaches.

On the basis of the mapped mooring/anchorage areas, the habitat types which are likely to be significantly affected through such activities will be identified. A quantitative assessment of the impacts associated with different anchoring/mooring practices in relation to sensitive habitats will be undertaken through localised and targeted surveys within selected marine areas. Such an assessment may also include an indication of the costs of degradation. Various experts will then be brought together to identify management options as applicable to the different types of anchoring activity, with a view to address the verified impacts of mooring/anchoring activity on seabed habitats. These options will be subjected to a prioritisation exercise on the basis of sensitivity of affected habitats and technical feasibility. An economic assessment of the preferred options will also be undertaken to ensure cost-effectiveness of selected options.

On the basis of the outcome of this study and of relevant stakeholder consultations, this action will implement selected priority option/s on a pilot basis. The outcome of this pilot exercise will be monitored to assess whether both ecological objectives and the demands of the users can be reached with a view to inform management processes in the longer term.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	C14: Anchoring and mooring surveys
Project Title:	Spatial analysis of recreational boating as a first key step for marine spatial planning in Mallorca (Balearic Islands, Spain)
Project Acronym/ID:	Not available

Project Duration:	Paper published in 2011
Project Status:	Completed
Funding Programme:	Not available
Key Contacts:	<p>Pablo Balaguer</p> <p>Sistema d'Observació i Predicció Costanera de les Illes Balears (SOCIB), Edifici Naorte, Bloc A, 2on n°3, ParcBit. Carretera de Valledemossa km 7.4, 07021 Palma de Mallorca, Mallorca, Spain</p> <p>vdctpbh4@uib.es</p>

#### Project Summary

Recreational boating is an important, growing leisure activity on the island of Mallorca, Balearic Islands, Spain. This spatial analysis of anchoring of recreational boating along the coast of Mallorca is intended to generate new data to contribute to the achievement of a comprehensive marine and coastal spatial planning on the island in addition to providing important information related to the pressure of increasing demand for anchoring space that, if not properly managed, could jeopardize the coastal and marine environments. The study combines data from the natural (habitats, geology), physical (wave patterns), and social sciences (survey interviews), using Geographic Information Systems (GIS) as the main analytical tool. The final result is an estimate of the average amount of seabed available for anchoring during the highest levels of boating activity in Mallorca (i.e. summer high season) based on a number of different sustainability scenarios (i.e. average distance between boats, weather conditions). In addition to being applicable to any location wishing to manage recreational boating activity, the methodology presented in this study represents an integrated, multidisciplinary approach which could be applied to a number of management scenarios with a spatial dimension in marine environments.

This paper provides an approximation of the capacity of the coastal zones (seabeds available for anchoring). The results can be a decision tool for the proper management of the coastal zone. The work is based on the use of GIS (Geographic Information Systems). The developed method is applicable to any coastal area and is considered useful for the future management.

Descriptive keywords:	recreational boating, anchoring, marine spatial analysis, GIS
Project Website:	<a href="https://www.sciencedirect.com/science/article/pii/S0964569110002127?via%3Dihub">https://www.sciencedirect.com/science/article/pii/S0964569110002127?via%3Dihub</a>

#### Key Deliverables/Publications and Links

<https://www.sciencedirect.com/science/article/pii/S0964569110002127?via%3Dihub>

Relevant LIFE IP Concrete Action:	C14: Anchoring and mooring surveys
Project Title:	Assessing the environmental impact of anchoring cruise liners in Falmouth bay



	(Chapter 6.0. from Gibson, P., Papathanassis, A., & Milde, P. (2011). Cruise sector challenges: Making progress in an uncertain world. Wiesbaden: Gabler Verlag.)
Project Acronym/ID:	Not available
Project Duration:	Book published in 2011
Project Status:	Completed
Funding Programme:	Knowledge Transfer Partnerships (Falmouth University) (programme funded by UK public sector)
Key Contacts:	Dr. Sarah Tuck International Shipping and Logistics Group School of Management Plymouth Business School, University of Plymouth, Plymouth, UK S.Tuck@plymouth.ac.uk
<u>Project Summary</u>  <p>Ports are coming under increasing pressure to manage their operations in an environmentally sustainable manner. This pressure comes from legal requirements, national agencies, planning inquiries and local activists (Wooldridge et al 1999). Ports have tended to react to such demands by making environmental policies and audits, always playing catch-up to the latest problem. An alternative approach is to be pro-active in seeking out environmental concerns at an early stage, assessing the scientific evidence of harm in the context of the specific port, and taking mitigating action according to the evidence. This is the basis of a Knowledge Transfer Partnership between the University of Plymouth and Falmouth Harbour Commissioners (FHC), who run a small trust port in South West England. The Port of Falmouth enjoys over thirty cruise calls a year. Smaller cruise liners can berth within the docks, but larger ships must anchor in Falmouth Bay, a Marine Special Area of Conservation, and tender their passengers ashore. Anchoring directly affects the benthic habitat through smothering, abrasion and disturbance. The noise and visual intrusion of vessels create an indirect impact. Studies into anchoring activities in fragile habitats such as eelgrass beds have led to the strict management of anchoring (Milazzo et al 2002). Falmouth Bay has a rare dead maerl habitat. This paper presents the on-going study, which is assessing the potential environmental impacts of anchoring in the Falmouth bay area. The steps include synthesising existing data on the nature of the seabed, recording actual anchor locations within the bay to identify areas of high anchoring density and identifying the threat that anchoring poses to the species in the maerl habitat. It is known that there are bivalves that live below the surface, so comparative core samples will be air lifted from high and low anchoring density areas.</p>	
Descriptive keywords:	environmental impact assessment, anchoring
Project Website:	<a href="https://link.springer.com/chapter/10.1007/978-3-8349-6871-5_6">https://link.springer.com/chapter/10.1007/978-3-8349-6871-5_6</a>
<u>Key Deliverables/Publications and Links</u>  ebook: <a href="https://books.google.com.mt/books?hl=en&amp;lr=&amp;id=3XZr_gMA1F0C&amp;oi=fnd&amp;pg=PA93&amp;ots=iS95HHHPbl&amp;sig=TgjC8dderihEHIL-JAxF1rzhgo&amp;redir_esc=y#v=onepage&amp;q&amp;f=false">https://books.google.com.mt/books?hl=en&amp;lr=&amp;id=3XZr_gMA1F0C&amp;oi=fnd&amp;pg=PA93&amp;ots=iS95HHHPbl&amp;sig=TgjC8dderihEHIL-JAxF1rzhgo&amp;redir_esc=y#v=onepage&amp;q&amp;f=false</a>	

or

[https://link.springer.com/chapter/10.1007/978-3-8349-6871-5\\_6](https://link.springer.com/chapter/10.1007/978-3-8349-6871-5_6)

Relevant LIFE IP Concrete Action:	C14: Anchoring and mooring surveys
Project Title:	Modeling the influence of attitudes and beliefs on recreational boaters' use of buoys in the Balearic Islands
Project Acronym/ID:	Not available
Project Duration:	Paper published in 2013
Project Status:	Completed
Funding Programme:	Project co-financed by the Spanish Ministry of Industry, Energy, and Tourism <u>and</u> the 2008-11 National Plan for Research, Development and Technological Innovation (Project TSI-020100-2010-852: TECHSEA: Platform for management and control of boats and buoys, moorings and buoys synchronized with localization and identification devices and ecological buoys = <i>Plataforma de gestión y control de barcos, amarres y boyas, sincronizada con dispositivos de localización e identificación y boyas verdes.</i> )
Key Contacts:	Dr. Amy Deidrich  School of Earth and Environmental Sciences, James Cook University, Townsville, Queensland 4811, Australia. Tel.: +61 (0) 74781 4627; fax: +61 (0) 74781 4020  E-mail address: <a href="mailto:amy.diedrich@jcu.edu.au">amy.diedrich@jcu.edu.au</a>

### Project Summary

Recreational boating is a globally significant nature-based industry, which can degrade sensitive benthic habitats through physical damage from anchors. Mooring buoys can eliminate this impact and lead to additional benefits such as more efficient use of space, increasing the well-being and safety of boaters, and generating revenue through user fees. Evidence that buoys positively influence the well-being of users, especially if this is reflected in a willingness to pay, may provide motivation to decision-makers to invest in this management measure yet, to the best of our knowledge, relatively little is known about what motivates boaters to use buoys. Based on the theory of reasoned action, this study uses the classification tree method to model the influence of behavioral and normative beliefs on two dependent variables; boaters' perceived likelihood to use buoys and willingness to pay (WTP) in a Marine Protected Area (MPA) located in a heavily used Bay on the island of Mallorca in the Balearic Islands of Spain. This MPA was designated to protect *Posidonia oceanica*, an endemic seagrass in the Mediterranean, which has been significantly degraded by structural damage from anchors. Data were collected using a survey instrument administered to recreational boaters in the summer of 2011. The data showed overall user support for buoys, and a positive relationship between attitudes (associated with perceptions of safety, space, and minimizing impacts on *P. oceanica*) and WTP and behavioral

intent. The data also indicated a positive influence of awareness of the potential negative impacts of anchoring on *P. oceanica* and the role of buoys in minimizing these effects on both dependent variables. Attitudes towards crowding in the study site had a very minor influence and normative beliefs did not feature as predictors in our models. The study is part of a larger research initiative to assess the physical, social, and environmental dimensions of recreational boating on the island of Mallorca. The theoretical framework, data collection and statistical assessment methods are broadly applicable to interdisciplinary research on use of coastal and marine space.

Descriptive keywords:	Recreation boating, <i>Posidonia oceanica</i> , mooring buoys
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Project Website:	<a href="https://www.sciencedirect.com/science/article/pii/S0964569113000707">https://www.sciencedirect.com/science/article/pii/S0964569113000707</a>
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#### Key Deliverables/Publications and Links

Academic paper:

<https://www.sciencedirect.com/science/article/pii/S0964569113000707>

Relevant LIFE IP Concrete Action:	C14: Anchoring and mooring surveys
Project Title:	Recreational and commercial anchoring and mooring impacts in marine protected areas in Wales and England - ME6003
Project Acronym/ID:	Not available
Project Duration:	2015-2016
Project Status:	Completed
Funding Programme:	Project implemented by the Marine Biological Association (MBA, UK) and funded by the Department for Environment, Food and Rural Affairs (DEFRA, UK).
Key Contacts:	Defra Marine and Fisheries Science Unit: <a href="mailto:marinescience@defra.gsi.gov.uk">marinescience@defra.gsi.gov.uk</a>

#### Project Summary

This project aims to improve the evidence base for anchoring and mooring impacts to allow identification of risks to sensitive features from anchoring and mooring. This will help to inform socio-economic evidence used for designation decisions and will support the development of effective management measures. It will inform statutory nature conservation bodies and marine regulators.

##### Objective

1. Undertake an independent review and analysis of available evidence on the impacts of anchoring and mooring. Summarise the UK MPA features that could be sensitive to impacts from anchoring and mooring and any published agreed limits and/or thresholds.

2. Summarise the location of MPA features which may be sensitive to anchoring and mooring within England and Wales. Collate spatial information on the scale and temporal frequency and intensity of anchoring and mooring within these potentially sensitive MPAs, and present an overview of this information.

3. Using information gathered under objectives 1 and 2, identify MPA sites where anchoring and mooring activities could result in impacts incompatible with site integrity and conservation objectives. Develop and present a methodology and sliding scale to describe the likelihood and level of environmental risks. Where sufficient evidence is available, apply this approach to identify the risk and scale of risk at protected sites.

4. Review the site history of a number of UK case studies including anchoring and mooring activities that have occurred within the site, why the activities have occurred there, and where and how management measures within the site have been developed (if applicable).

5. Provide a high-level summary of the organisation responsibilities for control of anchoring/mooring in England and Wales. Map the cross-over between MPA conservation objectives and objectives for WFD, MSFD and existing marine plans (or the Marine Policy Statement) for England and Wales to highlight likely synergies and gaps regarding requirements for anchoring and mooring evidence and how these could be best met in a streamlined way by the organisation involved. Identify whether a central repository of anchoring/mooring information might be accessed by all to provide the most consistent and comprehensive management and conservation.

6. Draw conclusions with regards the adequacy of existing anchoring/mooring activity distribution and impacts evidence to inform management and whether it accounts for in-combination or cumulative impacts. Clearly summarise the major evidence gaps and limitations within this context and provide detailed recommendations in the form of a research action plan to address these evidence gaps and improve the future evidence base supporting conservation and management.

Descriptive keywords:	anchoring and mooring, MPAs
Project Website:	<a href="http://randd.defra.gov.uk/Default.aspx?Module=More&amp;Location=None&amp;ProjectID=19777">http://randd.defra.gov.uk/Default.aspx?Module=More&amp;Location=None&amp;ProjectID=19777</a>

#### Key Deliverables/Publications and Links

Two page summary:

[http://randd.defra.gov.uk/Document.aspx?Document=13392\\_ME6003twopagesummary.pdf](http://randd.defra.gov.uk/Document.aspx?Document=13392_ME6003twopagesummary.pdf)

Powerpoint presentation:

<http://swmecosystems.co.uk/wp-content/uploads/2016/02/21.-Olivia-Langmead-Anchoring-Mooring-in-MPAs.pdf>

***DEFRA may be contacted for more detailed deliverables.***

Relevant LIFE IP Concrete Action:	C14: Anchoring and mooring surveys
Project Title:	Management guide for marine protected areas of the Mediterranean sea: Permanent ecological moorings
Project Acronym/ID:	Not available
Project Duration:	Guidebook published in 2006
Project Status:	Completed

Funding Programme:	INTERREG IIIC programme
Key Contacts:	Professeur Patrice Francour ECOMERS, CNRS, Université Nice Sophia Antipolis, France <a href="mailto:francour@unice.fr">francour@unice.fr</a>
<p><u>Project Summary</u></p> <p>'Permanent Ecological Moorings' was designed as a guide for managers of coastal or marine areas and for all the administrative and associative structures who face the recurrent problems of moorings. This guide summarizes key issues and shows the various choices available as well as being a technical guide. It wants to answer the main questions that one faces while managing the diverse activities involved in mooring and anchorage.</p> <p>Anchorage or mooring? The authors of this guide have voluntarily considered that the two terms are synonymous. Two categories of anchorage (or mooring) can be defined: temporary mooring and permanent mooring. A permanent mooring cannot be moved quickly or easily. A temporary mooring is (usually) an anchor stored onboard a boat (or a floating structure that needs to be clamped down) and is re-hauled onboard when the boat starts to move again.</p> <p>The act of mooring with an anchor means, dropping an anchor overboard to enable the immobilization of a boat because the anchor falls and is wedged onto the bottom. When removed, this anchor will be pulled up forcibly in order to be freed from the seabed. Depending on the fragility of the seabed or of the sea life (animals or plants) that are developing there, the impact can be significant. The areas most adapted to moorings are dependent on hydrological factors (currents, wave exposure) and meteorological factors (wind exposure). Along a stretch of coast these areas are not especially numerous and the pressure of moorings on the seabed can be frequent and significant.</p> <p>Every manager or organization in charge of managing a coastal marine area will be facing this choice: preserve as good as possible the seabed or allow unregulated moorings with all the potential negative results that can ensue. In addition to general boat use, the managers themselves may need to moor: their own boats, permanent floating structures (pontoon, barge, buoy) or immersed structures (canalization, sign for diving trail). How does one choose in cases like these an ecological solution that has minimal negative impact for the environment?</p> <p>This guide will help in the choice of the most adapted ecological solution depending on the environment in question. It is divided into two main parts: the description of the major environments and the technical description of various permanent ecological moorings recommended.</p> <p>Five main categories of environments have been selected: sand and mud, Pebbles and cobbles, Boulders and bedrock, Coralligenous formations, and Posidonia meadows. Each environment is briefly described and its ecological importance is detailed. The sensitivity and vulnerability of each of these environments are then evaluated depending on their particular characteristics: speed of regeneration, structural complexity (its architecture), ecological role, etc. These elements should enable us to understand why one environment is more or less fragile and why it is necessary to look for alternative solutions to moor with an anchor.</p>	

The technical solutions include a description of the immersed parts (the ones laid on or pushed into the sea bed) and the parts at the surface without forgetting the connecting elements between the surface and the bottom. Advice on the installation is also given. When many solutions are possible for a given environment they are presented in a comparative table in a synthetical manner that will help the manager to choose the optimum solution taking into account the usage, the quality of the substrate, and the estimated effort involved.

Please note: if this guide shows the various choices between the different technical solutions, in no way does it pretend to be nor replace a technical manual necessary to calibrate the mooring. Furthermore, it does not address the juridical issues attached to problems of authorization or management of moorings.

If the place for a mooring does not need to be at a precise location, a manager might then have the choice between different substrates. In order to help this choice a table summarizes the vulnerability of each environment, from the least to the most sensitive and vulnerable.

At the end of this guide three appendixes give additional information: a list of bibliographic references, a glossary and a list of contact addresses. The glossary defines the terminology used in both the descriptive environment and the technical part. This terminology is written in blue in the text. The contact appendix contains a non-exhaustive list of addresses or Internet sites in the assessment, installation, sale or calibration of ecological solutions for permanent moorings.

Descriptive keywords:

ecological moorings

Project Website:

[https://www.researchgate.net/publication/234026765\\_2006\\_Francour\\_et\\_al\\_Ecological\\_Moorin\\_g](https://www.researchgate.net/publication/234026765_2006_Francour_et_al_Ecological_Moorin_g)

[http://www.medmpaforum.org/sites/default/files/ancrages\\_ecologiques\\_en.pdf](http://www.medmpaforum.org/sites/default/files/ancrages_ecologiques_en.pdf)

#### Key Deliverables/Publications and Links

Publication:

[https://www.researchgate.net/publication/234026765\\_2006\\_Francour\\_et\\_al\\_Ecological\\_Moorin\\_g](https://www.researchgate.net/publication/234026765_2006_Francour_et_al_Ecological_Moorin_g) ;  
[http://www.medmpaforum.org/sites/default/files/ancrages\\_ecologiques\\_en.pdf](http://www.medmpaforum.org/sites/default/files/ancrages_ecologiques_en.pdf)

## Action C.15: Impact of Reverse Osmosis discharges on the marine environment

### Brief Description of the Concrete Action

The lead Beneficiary for this action is the Water Services Corporation who shall be responsible for the overall coordination and implementation of the action.

The objective of this action is to investigate and determine the impact of brine discharge from Reverse Osmosis (RO) plants to the marine environment. Given the insufficient natural water availability to satisfy the national water demand, Malta is dependent on the production of freshwater through three RO plants in order to satisfy its water requirements. These RO plants are located on different parts of

the Maltese coastline and the reject water of this process (brine) is being discharged into the coastal water surrounding the islands.

Studies in other similar environments have shown that brine discharges from RO plants could have adverse impacts on the receiving marine environment. So far, no studies have been done locally on the potential impact to marine ecosystems resulting from the discharge of brine water into these coastal waters. In this regard, this action shall focus on the development of a monitoring program with the aim of understanding the impacts of brine being discharged into the marine environment.

The sampling programme shall cover a period of two years so as to ensure that:

- 1) The sampling program captures any seasonal variations in the quantity of brine being discharged into the marine environment.
- 2) Due consideration is given to the changing hydrodynamic conditions and how these impinge upon brine and seawater mixing.
- 3) Ensure that a wide enough area, or zone of influence, is covered in the area where the brine is being discharged.

This concrete action will build on the results of preparatory Action A.7 (Hydrographical Modelling) since the output of this preparatory action will provide the information necessary to determine the interaction between RO discharges and local hydrodynamic conditions.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	C.15 - Impact of Reverse Osmosis discharges on the marine environment
Project Title:	Re-designing the value and supply chain of water and minerals: a circular economy approach for the recovery of resources from saline impaired effluent (brine) generated by process industries
Project Acronym/ID:	ZERO BRINE
Project Duration:	01/06/2017-31/05/2021
Project Status:	Ongoing
Funding Programme:	H2020
Key Contacts:	<p>Name Roelof Moll Email: info@tudelft.nl Institution: TU Delft</p> <p>Name Linda Roos Email info@tudelft.nl Institution: TU Delft</p>
<u>Project Summary</u>  <p>This project aims to facilitate the implementation of the Circular Economy package and the SPIRE Roadmap in various process industries by developing the necessary concepts, technological solutions and business models to re-design the value and supply chains of minerals (including magnesium) and water, while dealing with present organic compounds in a way that allows their</p>	

subsequent recovery. This is achieved by demonstrating new configurations to recover these resources from saline impaired effluents (brines) generated by process industry, while eliminating wastewater discharge and minimising environmental impact of industrial operations through brines (ZERO BRINE). The project will bring together and integrate several existing and innovative technologies aiming to recover end-products of high quality and sufficient purity with good market value. It will be carried out by large Process Industries, SMEs with disruptive technologies and a Brine Consortium of technology suppliers across EU, while world-class research centres ensure strong scientific capacity and inter-disciplinary coordination to account for social, economic and environmental considerations, including LCA. A large scale demonstration will be developed in the Energy Port and Petrochemical cluster of Rotterdam Port, involving local large industries. Two demo plants will be able to treat part of the brine effluents generated by one process industry (EVIDES), while the waste heat will be sourced by neighbouring factories. The quality of the recovered end-products will be aimed to meet local market specifications. The involvement of representatives covering the whole supply chain will provide an excellent opportunity to showcase Circular Economy in Rotterdam Port, at large scale. Finally, three large-scale pilot plants will be developed in other process industries, providing the potential for immediate replication and uptake of the project results after its successful completion.

Descriptive keywords:	Circular economy, recovery of resource, brine from process industries
Project Website:	<a href="https://zerobrine.eu/">https://zerobrine.eu/</a> <a href="https://cordis.europa.eu/project/id/730390">https://cordis.europa.eu/project/id/730390</a>

#### Key Deliverables/Publications and Links

Pilot Project – Desalination Plant in the Botlek area in the Netherlands amongst other pilot projects related to process industries.

Relevant LIFE IP Concrete Action:	C.15 - Impact of Reverse Osmosis discharges on the marine environment
Project Title:	Zero Liquid Discharge desalination: brine treatment based on electrodialysis metathesis and valuable compound recovery
Project Acronym/ID:	LIFE+ ZELDA
Project Duration:	July 2013 - June 2017
Project Status:	Completed
Funding Programme:	LIFE+
Key Contacts:	Name: Xavier MARTÍNEZ Email: xavier.martinez@ctm.com.es Institution: CTM Centre Tecnològic

#### Project Summary

The main objective of ZELDA project is to demonstrate and disseminate the technical feasibility and economical sustainability of decreasing the overall environmental impact of desalination systems for freshwater production by adopting brine management strategies based on the use of electrodialysis metathesis (EDM) and valuable compound recovery processes with the final aim of reaching a zero-liquid discharge (ZLD) process. The project duration is 4 years (July 2013 - June



2017). The second half of the project is focused on the demonstration of the new technology in two desalination plants located at Almeria (seawater desalination) and Málaga (brackish water desalination). The project will include activities to validate and optimize the technology at laboratory scale, to design the best strategy for the recovery of valuable compounds and the evaluation of the environmental and economic impact of the technology.

Descriptive keywords: Zero-liquid discharge, resource recovery

Project Website: <http://life-zelda.eu/en>

#### Key Deliverables/Publications and Links

Innovative brine treatment strategy based on EDM and valuable compound recovery:  
[http://life-zelda.eu/en/downloads/annex\\_7-3-6-idawc\\_paper.pdf/@download/file/Annex\\_7.3.6-IDAWC\\_paper.pdf](http://life-zelda.eu/en/downloads/annex_7-3-6-idawc_paper.pdf/@download/file/Annex_7.3.6-IDAWC_paper.pdf)

Relevant LIFE IP Concrete Action:	C.15 - Impact of Reverse Osmosis discharges on the marine environment
Project Title:	Development of an advanced, innovative, energy autonomous system for the treatment of brine from seawater desalination plants
Project Acronym/ID:	SOL-BRINE / LIFE09 ENV/GR/000299
Project Duration:	01/10/2010-31/12/2013
Project Status:	Completed
Funding Programme:	LIFE+
Key Contacts:	Name: Panagiotis Krontiras

#### Project Summary

The SOL-BRINE project aimed to develop a solar-driven brine treatment system in order to eliminate the current practice of brine disposal. The development of such a system is an innovative approach to finding a feasible solution to brine elimination. The proposed SOL-BRINE prototype system for brine treatment will produce two by-products: dry salt, which can be easily handled and used commercially, and water to be used for irrigation or other purposes.

The SOL-BRINE project developed a solar-powered brine treatment system, designed to eliminate the current practice of brine disposal into aquatic environments. This brings added value in that the significant environmental problem of brine disposal can be solved, while at the same time marketable products (salt and water) can be generated. The project's energy-autonomous brine treatment system is in operation on Tinos, a Greek island situated in the Aegean Sea within the Cyclades archipelago, at the existing desalination plant in the Agios Fokas area.

The energy-autonomous brine treatment system comprises an evaporator, a crystalliser, and a dryer. It recovers high-quality water with the potential of variable water uses (including also industrial use) and solid salts. The project team is currently investigating possibilities to separate these salts in order to obtain commercial products, therefore promoting a circular economy. The project connected the Photovoltaic (PV) panel, and arranged the components, to optimise the

operational efficiency of the system. It was shown that its demonstration prototype could be replicated at full-scale in Tinos or in other regions with similar characteristics. The potential is high, given that there are approximately 45 desalination units in Greece alone, and many other units elsewhere in Europe.

Descriptive keywords:	Seawater desalination, resource recovery,
Project Website:	<a href="http://solbrine.uest.gr/index.php/en/">http://solbrine.uest.gr/index.php/en/</a>

#### Key Deliverables/Publications and Links

- Action 02: Design of an innovative, pilot-scale, energy-autonomous brine treatment system: <http://solbrine.uest.gr/index.php/en/actions/31-action-2-design-of-an-innovative-pilot-scale-energy-autonomous-brine-treatment-system>
- Action 03: Engineering, construction and installation of the innovative, pilot-scale, energy-autonomous, brine treatment system at the desalination plant of Tinos: <http://solbrine.uest.gr/index.php/en/actions/32-action-3-engineering-construction-and-installation-of-the-innovative-pilot-scale-energy-autonomous-brine-treatment-system-at-the-desalination-plant-of-tinos>
- Action 04: Operation and optimization of the pilot scale innovative energy– autonomous brine treatment system: <http://solbrine.uest.gr/index.php/en/actions/33-action-4-operation-and-optimization-of-the-pilot-scale-innovative-energy-autonomous-brine-treatment-system>
- Action 05: Overall evaluation of the pilot system’s environmental and economic performance/ LCA Analysis – Suggestions for full-scale implementation of the solar-driven brine treatment system: <http://solbrine.uest.gr/index.php/en/actions/34-action-5-overall-evaluation-of-the-pilot-system-s-environmental-and-economic-performance-lca-analysis-suggestions-for-full-scale-implementation-of-the-solar-driven-brine-treatment-system>
- Action 06: Alternative uses of “final salt product” and “vapor condensate” from the brine treatment system – Market opportunities in Greece: <http://solbrine.uest.gr/index.php/en/actions/35-action-6-alternative-uses-of-final-salt-product-and-vapor-condensate-from-the-brine-treatment-system-market-opportunities-in-greece>

Relevant LIFE IP Concrete Action:	C.15 - Impact of Reverse Osmosis discharges on the marine environment
Project Title:	Methodology for the design of Brine Discharges
Project Acronym/ID:	MEDVSA
Project Duration:	01/10/2010-31/12/2013
Project Status:	Completed
Funding Programme:	Funded by the Spanish Ministry of Rural Environment and Water of the Ministry of Food, Agriculture and Environment.
Key Contacts:	Name: Iñigo Losada Rodríguez Email: brihnecurso@ihcantabria.com

	Institution: Institute of Environmental Hydraulics (IH Cantabria) of the University of Cantabria, Spain
<p><u>Project Summary</u></p> <p>The general objective of the project is to make the use of desalination compatible, as a source of alternative water resources, with the quality assurance of the receiving coastal marine environment and with the protection of ecosystems. For this, a methodology has been developed, based on the application of technical-scientific tools, for the design of the brine discharge systems from desalination plants, thereby contributing to a more sustainable development. In order to achieve the general objective, the following specific objectives were raised:</p> <ul style="list-style-type: none"> <li>• Optimization of the systems and criteria for the dumping of brine into the sea of the Spanish desalination plants. This objective implies the realization of experimental tests in a small-scale physical model, both with traditional measurement methods, and with LIF and PIV techniques for the study of concentration and velocity fields; on the other hand, the development and calibration of numerical modelling tools for the simulation of the phenomenon and the validation of said tools with laboratory and field data obtained from campaigns in discharges of desalination plants in operation.</li> <li>• Development of a general methodology for conducting studies, where all aspects to be considered in the design are taken into account: effluent characterization, location of the discharge; most suitable download system; characterization of the climatic scenarios of the receiving marine environment, Numerical Modelling of the phenomenon; environmental quality standards according to the present ecosystems and establishment of environmental monitoring plans, among others.</li> </ul>	
Descriptive keywords:	Seawater reverse osmosis, brine discharge, modelling tools, methodological guide, environmental impact
Project Website:	<a href="http://www.medvsa.es/index.aspx">http://www.medvsa.es/index.aspx</a>
<p><u>Key Deliverables/Publications and Links</u></p> <ul style="list-style-type: none"> <li>• MEDVSA: A methodology for design of brine discharges into seawater <a href="http://www.medvsa.es/difusion/Articulos/MEDVSA_DWR.pdf">http://www.medvsa.es/difusion/Articulos/MEDVSA_DWR.pdf</a></li> <li>• Documents and models available on their website: <a href="http://www.medvsa.es/herramientas/index.html">http://www.medvsa.es/herramientas/index.html</a></li> </ul>	

## Action C.16: Hydrographic model simulations for Malta's marine waters to quantify and investigate pressures in the marine environment

### Brief Description of the Concrete Action

The Physical Oceanography Research Group within the University of Malta will be in charge of coordinating the implementation of this action.

This action involves the determination of baseline hydrographical conditions for coastal and offshore Maltese waters and the use of this baseline data to characterise pressures and impacts on the marine

environment. For this purpose, the hydrographical models selected in preparatory action (A.7) will be run and the baseline conditions against which changes to hydrographical changes can be assessed will be set through this model. The hydrographical model will enable the characterisation of Malta's hydrographical conditions in terms of the parameters or characteristics listed in both the EU Marine Strategy Framework Directive (2008/56/EC) and the EU Water Framework Directive (2000/60/EC), including inter alia current velocity, upwelling, wave exposure, mixing characteristics and residence time.

The baseline hydrographical model will be interpreted in relation to the characterisation of hydrological input from land-based sources at major catchment nodes developed as part of Preparatory Action A.8 (Catchment Modelling). This will allow for the understanding of the behaviour of pollutants once they reach the marine environment through storm-water run-off at selected major catchment nodes will be simulated on the basis of the baseline hydrographical conditions and data from the characterisation of storm water flow and quality with a view to map the extent of coastal waters affected by diffuse land-based sources of pollution. Such simulation would enable links between measured levels of pollutants (including nutrients, contaminants and marine litter) in marine monitoring stations to land-based sources of such pollutants. Within this context, this action can be linked with the management of Malta's valley systems as major channels of water runoff to the sea, since it will lead to better understanding of the impacts of such run-off in the marine environment and further inform management needs for valley systems.

The baseline hydrographical model will also be used through this action for better understanding of potential transboundary sources of contaminants reported in Maltese marine waters. Through the Mediterranean network established for the purpose of preparatory action A.7, the baseline hydrographical model for Malta will be used in conjunction with available regional models to simulate current circulation and contaminants transport, with a view to determine the potential role of transboundary sources in contributing to marine contamination and marine litter as identified through Malta's monitoring programme for the marine environment. Such a simulation will be based on knowledge of the contaminants' concentration, decay rates and dispersion coefficients.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	C16: Hydrographic model simulations for Malta's marine waters to quantify and investigate pressures in the marine environment
Project Title:	Gliders for Research, Ocean Observation and Management/ 284321
Project Acronym/ID:	GROOM
Project Duration:	2011-2014
Project Status:	Completed
Funding Programme:	FP7-INFRASTRUCTURES
Key Contacts:	Name: Pr. Laurent Mortier and Dr. Pierre Testor Laboratoire d'Océanographie et de Climatologie : Expérimentations et Approches Numériques (LOCEAN-IPSL)

	Institut Pierre Simon Laplace Université Pierre et Marie Curie, aile 45-55, 4ème étage, case 100 4, Place Jussieu 75252 Paris cedex 05, France Phone: +33 1 4427-7275 Fax: +33 1 4427-3805 Email: laurent.mortier@locean-ipsl.upmc.fr Institution: LOCEAN-IPSL
<p><u>Project Summary</u></p> <p>The EU-funded GROOM (Gliders for research, ocean observation and management) project set out to fill gaps in current marine research infrastructures (RIs) for the benefit of science, industry and society. The new European infrastructure is based on several dedicated gliderports for the maintenance and operation of European gliders.</p> <p>GROOM scientists investigated and documented the advantages of using gliders for ocean prediction and optimal sampling in the OOSs as well as the policy and management of data collected by gliders. Authorities were approached regarding safety and legal aspects of glider operations and possible financial models were reviewed. In addition, the team carried out studies on performing synergistic experiments with other platforms and the testing of new sensors.</p> <p>Project partners studied the innovation aspect of operating gliders. They analysed a variety of novel sensors available in the market and under development, as well as their readiness for gliders. These sensors pave the way for broad perspectives in the design of experiments with gliders for physical, chemical and biological ocean research.</p> <p>Data flow and work flow protocols and formats were developed. GROOM also defined and implemented a dedicated data management system for gliders in Europe.</p> <p>Trial glider deployments were undertaken to test and assess the designed fleet operation techniques. Synergies with other ocean observing platforms were also explored, including testing sensor deployment. The team analysed existing European glider infrastructure and defined a future European infrastructure for gliders based on the current state of play.</p> <p>GROOM drew up a roadmap to establish and implement a European RI during the period 2015-2020. It will be most useful for academic oceanographic research and operational oceanography systems, which provide crucial information on marine activities to the commercial sector, governmental organisations and recreational users.</p>	
Descriptive keywords:	Glider, ocean observing platforms, research infrastructures, ocean prediction
Project Website:	<a href="http://www.groom-fp7.eu/doku.php?id=public:contact">http://www.groom-fp7.eu/doku.php?id=public:contact</a>
<p><u>Key Deliverables/Publications and Links</u></p> <p>Data flow within the Glider European Research Infrastructure  <a href="http://cordis.europa.eu/docs/results/284/284321/final1-geri-dataflow.pdf">http://cordis.europa.eu/docs/results/284/284321/final1-geri-dataflow.pdf</a></p> <p>Helping marine science reach new depths</p>	

<http://cordis.europa.eu/docs/results/284/284321/final1-groom-international-innovation-2volets.pdf>

Modular Organization of the Glider European Research Infrastructure

<http://cordis.europa.eu/docs/results/284/284321/final1-geri-modular-organization.pdf>

GROOM Deliverables (in general – mainly minutes of meetings etc.):

<http://www.groom-fp7.eu/doku.php?id=public:deliverables>

Relevant LIFE IP Concrete Action:	C16: Hydrographic model simulations for Malta's marine waters to quantify and investigate pressures in the marine environment
Project Title:	Biosensors, Reporters and Algal Autonomous Vessels for Ocean Operation/614010
Project Acronym/ID:	BRAAVOO
Project Duration:	2013-2016
Project Status:	Completed
Funding Programme:	FP7-KBBE
Key Contacts:	Name: Jan Roelof Van Der Meer UNIVERSITE DE LAUSANNE Quartier Unil-Centre Bâtiment Unicentre 1015 LAUSANNE Switzerland Email: janroelof.vandermeer@unil.ch Institution: UNIVERSITE DE LAUSANNE

#### Project Summary

Marine environments are threatened by pollution through a variety of activities, both directly and indirectly. The varying types, sources, levels and impacts of pollution in marine environments make it very difficult to develop efficient monitoring tools. In addition, monitoring strategies need to be adapted de-pending on the “use” of the marine environment (e.g., aquafarming, tourism, transport) or for the quality of marine environments as natural ecosystems themselves. The major aim of the BRAAVOO project and its contribution to the Ocean of Tomorrow program (FP7-OCEAN-2013) is to develop innovative solutions for measurement of high impact and difficult to measure marine pollutants. In contrast to classical environmental analytics, which is based on site sampling, ex-situ sample extraction and purification, and high-end sophisticated compound detection, the strategy of BRAAVOO is to provide near real-time in-situ sampling and analysis.

The BRAAVOO concept of near real-time in-situ sampling and analysis is based on the use of three types of biosensors, to enable both the detection of a number of specific marine priority pollutants and also of general biological effects that can be used for early warning. The first type of biosensor uses label-free antibody-based immuno-sensing on innovative nanooptical platforms such as bimodal evanescent waveguides or asymmetric Mach-Zehnder interferometers. The second sensing platform consists of live bacterial “bioreporters,” which produce bioluminescence in

response to chemical exposure. Finally, the photosystem II fluorescence of marine algae is exploited to monitor changes induced by toxic compounds.

BRAAVOO has rigorously tested the three biosensor systems for their analytical performance, responding to a set of targeted pollutants that include algal toxins, heavy metals, organic compounds related to oil, and antibiotics. To enable low-cost real-time measurements, the three biosensors were miniaturized, multiplexed and integrated into biosensing instruments, which allow simultaneous multianalyte detection. The instruments include the optical elements for biosensor signal generation and readout, the microelectronics for data storage, and specific macro- and microfluidics to expose the biosensors to the aqueous samples or calibration solutions. The modules were tested as stand-alone instruments with manual operation (e.g., sample addition manually), and were integrated in a marine buoy and an un-manned surveying vessel (USV). Integrated sensor instruments could be operated autonomously and remotely, store and transmit data to a remote observer. The performance of the stand-alone biosensors and biosensors in their integrated form was tested at field sites in Italy and Ireland and was further bench-marked using spiked marine samples with known target compound concentrations. Comparative chemical analytics showed reasonable agreement between the two types of measurements, although limits of detection in biosensor measurements without sample pre-treatment were generally (and not surprisingly) higher than in chemical analytics with extensive sample purification and concentration.

Overall, the developed biosensors and biosensor instruments allow flexible and innovative solutions for marine monitoring in terms of efficiency (sample analysis in hours instead of the days or weeks needed for standard sampling, transport to external labs and subsequent analyses) and cost. Further bench-marking on real samples and sites will be necessary to improve the robustness of the biosensor instruments and protocols, and to validate the biosensors' responses in comparison to classical analytics.

Descriptive keywords:	Biosensors, in-situ, USV (Un-manned surveying vessel), pollution, contaminants
Project Website (include a link)	<a href="http://www.braavoo.org">http://www.braavoo.org</a>

#### Key Deliverables/Publications and Links

Final Summary report:  
<http://cordis.europa.eu/docs/results/614/614010/final1-braavoo-final-sum-report-vs3-pu.pdf>

Relevant LIFE IP Concrete Action:	C16: Hydrographic model simulations for Malta's marine waters to quantify and investigate pressures in the marine environment
Project Title:	MyWave: A pan-European concerted and integrated approach to operational wave modelling and forecasting – a complement to GMES MyOcean services
Project Acronym/ID:	MYWAVE/284455
Project Duration:	2012-2014
Project Status:	Completed

Funding Programme:	FP7-SPACE
Key Contacts:	<p>Oyvind Saetra  The Norwegian Meteorological Institute  PO Box 43 Blindern  0313 Oslo  Norway  Institute: The Norwegian Meteorological Institute  Email: oyvind.saetra@dnmi.no</p>
<p><u>Project Summary</u></p> <p>The Global Monitoring for Environment and Security (GMES) initiative, now called Copernicus, provides valuable climate and weather information to various end users, including academia and business. One of these services, namely wind and wave forecasting, can be improved by integrating ocean wave data and by linking atmosphere and ocean models.</p> <p>Funded by the EU, the MYWAVE (A pan-European concerted and integrated approach to operational wave modelling and forecasting - a complement to GMES MYOCEAN services) project aimed to complete the groundwork needed to establish new GMES products that will offer users a more complete picture of the world's oceans.</p> <p>Research was geared towards improving wind and water data handling and improving the physics of current wave models. It also produced new and more accurate wave forecasts using earth observations and defined standard methods for ocean wave modelling.</p> <p>Various local-area models were coupled to provide more accurate wind-wave interactions and incorporated better physical modelling of water on the ocean surface. Several new sources of data also contributed to the model, including satellite radar data and ocean wind data. Researchers also improved data assimilation through the use of neural networks and these sources used to cross-validate and remove errors in the model.</p> <p>Project partners focussed on implementing a fully assembled forecasting tool that employs the data and algorithms produced. The tool will reduce uncertainty in global system models and pave the way for the inclusion of ocean waves into GMES services.</p> <p>In addition, MYWAVE proposed a verification system to accompany delivery of wave forecasts via a Marine Core Service. It set out working procedures, data formats and governance that are compatible with the existing MYOCEAN verification system that will transfer into the Copernicus programme.</p> <p>The project provided improved wave models which were made available for assessment by national meteorological services and integration into operational services provided to European users. As well as the intrinsic value of accurate wave forecasts for industry and local authorities MYWAVE will also have significant scientific benefits.</p>	
Descriptive keywords:	Wind forecast, wave forecast, Copernicus, wind models, verification system
Project Website:	Currently unavailable



Key Deliverables/Publications and Links

Open Access Publications:

<https://arxiv.org/abs/1406.5039>[https://doaj.org/toc/1812-0792?source=%7B%22query%22%3A%7B%22filtered%22%3A%7B%22filter%22%3A%7B%22bool%22%3A%7B%22must%22%3A%5B%7B%22term%22%3A%7B%22index.issn.exact%22%3A%221812-0792%22%7D%7D%2C%7B%22term%22%3A%7B%22type%22%3A%22article%22%7D%7D%5D%7D%7D%2C%22query%22%3A%7B%22match\\_all%22%3A%7B%7D%7D%7D%7D%2C%22from%22%3A0%2C%22size%22%3A100%7D](https://doaj.org/toc/1812-0792?source=%7B%22query%22%3A%7B%22filtered%22%3A%7B%22filter%22%3A%7B%22bool%22%3A%7B%22must%22%3A%5B%7B%22term%22%3A%7B%22index.issn.exact%22%3A%221812-0792%22%7D%7D%2C%7B%22term%22%3A%7B%22type%22%3A%22article%22%7D%7D%5D%7D%7D%2C%22query%22%3A%7B%22match_all%22%3A%7B%7D%7D%7D%7D%2C%22from%22%3A0%2C%22size%22%3A100%7D)<http://archimer.ifremer.fr/doc/00102/21311/19567.pdf>

Open Access Database:

<https://zenodo.org/record/831329#.Wk4f5N-nHIU>

Relevant LIFE IP Concrete Action:	C16: Hydrographic model simulations for Malta's marine waters to quantify and investigate pressures in the marine environment
Project Title:	In situ monitoring of oxygen depletion in hypoxic ecosystems of coastal and open seas, and land-locked water bodies/226213
Project Acronym/ID:	HYPOX
Project Duration:	2009-2012
Project Status:	Completed
Funding Programme:	FP7-ENVIRONMENT
Key Contacts:	Antje Boetius, Felix Janssen (MPG-MPIMM) and Christoph Waldmann (Uni-HB) Email: <a href="mailto:aboetius@mpi-bremen.de">aboetius@mpi-bremen.de</a> Institute: MPG-MPIMM Max-Planck-Instituts für Marine Mikrobiologie

Project Summary

As well as being detrimental to life in an aquatic ecosystem, increases in hypoxia also affect the wider environment. Under hypoxic conditions, substantial losses in biodiversity, ecosystem function, and services such as fisheries, aquaculture and tourism can occur and additional greenhouse gases may be released from the ocean seafloor.

The EU-funded HYPOX project took the first steps towards implementation of a global observation system for better understanding oxygen changes in aquatic systems. Researchers monitored oxygen depletion and associated processes in target areas, which differed in oxygen status and sensitivity to change. They included the deep Arctic Ocean, the semi-enclosed waters of the Black and Baltic

Seas, fjords, and lagoons and land-locked lakes.

In order to maximise the knowledge generated by HYPOX, partners deployed a variety of reliable long-term sensors on different platforms for in situ monitoring of oxygen depletion and associated parameters. Targeted field campaigns were conducted to investigate the environmental impacts of hypoxia.

These impacts included the effect of hypoxia on the distribution of seafloor organisms as well as on biological and chemical processes involved in the large-scale cycling of elements. The consortium also adopted and refined numerical tools for predicting hypoxia and for separating natural variability from man-made changes.

Existing long-term monitoring data was also analysed to better understand the history of a water body's oxygenation status. Core samples were taken from the seabed of the Black Sea, as well as lagoons and lakes. These enabled scientists to examine the past, since a record of earlier biological and chemical conditions are preserved in the sediment.

Project results and modelling expertise will serve as a basis for accurate forecasts of oxygen depletion. This in turn will contribute to the planning of appropriately tailored climate change adaptation methods. Studies of previously eutrophied systems, such as the Swiss lakes, show how a reduction in nutrients from human activities can help alleviate the problem of oxygen depletion.

HYPOX has provided European policy and decision makers with the necessary knowledge of oxygen depletion in aquatic systems. This enables them to develop effective sustainable development strategies and negotiate internationally binding treaties.

Descriptive keywords:	Eutrophication, oxygen depletion, numerical model, long-term sensors, environmental impacts
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Project Website:	<a href="http://hypox.pangaea.de/">http://hypox.pangaea.de/</a>
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#### Key Deliverables/Publications and Links

Final report:  
<http://cordis.europa.eu/docs/results/226/226213/final1-hypox-m19-36-final-report-120803-200dpi.pdf>

Data portal:  
[http://hypox.pangaea.de/front\\_content.php?idcat=414](http://hypox.pangaea.de/front_content.php?idcat=414)

Relevant LIFE IP Concrete Action:	C16: Hydrographic model simulations for Malta's marine waters to quantify and investigate pressures in the marine environment
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Project Title:	Towards a joint European research infrastructure network for coastal observatories/262584
Project Acronym/ID:	JERICO
Project Duration:	2015-2018
Project Status:	Ongoing
Funding Programme:	FP7-INFRASTRUCTURES
Key Contacts:	Mr. Patrick Farcy IFREMER French Research Institute for Exploitation of the Sea France Email: patrick.farcy@ifremer.fr. Institute: IFREMER
<p><u>Project Summary</u></p> <p>Global warming and environmental pressures are endangering not only Europe's coasts but also the habitats and human development around them. For Europe to monitor its seas and coasts effectively and address these pressures, the continent's coastal observatories must join forces and work closely together.</p> <p>With this in mind, the EU-funded JERICO (Towards a joint European research infrastructure network for coastal observatories) project gathered European coastal observatories and encouraged joint research initiatives and standardisation through a unified European organisation for data management.</p> <p>Work began by taking stock of existing technology and methods, best practices and key challenges in order to lay down a common vision and strategy for coastal observatories. Project partners harmonised operation and maintenance methods by carrying out technical studies on various observing systems. They delivered best practice guidelines and quality control standards and introduced ways to enhance the service components of coastal observatories via technological improvements and innovation.</p> <p>Transnational access was offered to several unique European coastal observatories and calibration facilities for international research and technology development. This enabled scientists and engineers to freely access coastal infrastructures not otherwise available in their homelands. Transnational activities also helped to foster joint research initiatives across national boundaries.</p> <p>The JERICO team evaluated the management of distributed data from other infrastructures and European projects. It set up a dissemination platform to boost the visibility of JERICO and raise the awareness of industry, academia and government.</p> <p>JERICO introduced a networked infrastructure based on an end-to-end coastal monitoring process, from data acquisition to dissemination. It will improve environmental monitoring efforts and improve predictions of climate-related impacts.</p>	

Descriptive keywords:	Coastal data, oceans, coastal observatories, global ocean monitoring, JERICO
Project Website:	<a href="http://www.jerico-ri.eu/">http://www.jerico-ri.eu/</a>
<u>Key Deliverables/Publications and Links</u>  Article: <a href="http://cordis.europa.eu/docs/results/262/262584/final1-articl-int-inov_jerico.pdf">http://cordis.europa.eu/docs/results/262/262584/final1-articl-int-inov_jerico.pdf</a>  Final presentation: <a href="http://cordis.europa.eu/docs/results/262/262584/final1-presentation-jerico-recto-verso.pdf">http://cordis.europa.eu/docs/results/262/262584/final1-presentation-jerico-recto-verso.pdf</a> <i>Progress in marine science supported by European joint coastal observation systems: The JERICO-RI research infrastructure: DOI: 10.1016/j.jmarsys.2016.06.004</i> Deliverables: <a href="http://www.jerico-ri.eu/project-information/deliverables/">http://www.jerico-ri.eu/project-information/deliverables/</a>	

## Action C.17: Multi-stakeholder platform

### Brief Description of the Concrete Action

The Lead Beneficiary for this action is the Energy and Water Agency (EWA) who will be responsible for the overall coordination of the action. The action will also see the direct participation in the water table meetings of all the project beneficiaries, namely WSC, ERA, MTIP and MGoZ.

This action will seek the establishment of a multi-stakeholder water table involving both stakeholders from the public and private sectors (including water user associations and e-NGOs) who would meet regularly to assess the progress achieved in the implementation of the IP and the 2<sup>nd</sup> RBMP, look towards the development of the 3<sup>rd</sup> RBMP and discuss potential ways in which this implementation process can be optimised. In as much this action will ensure the establishment of a continuous process through which stakeholders are continuously involved and consulted in the implementation process of the Water Framework Directive. It is envisaged that the collaborative environment established through this water table would eventually make stakeholders feel more involved in the development of the approaches and measures required for the achievement of the WFD's Environmental Objectives thus facilitating the acceptability and uptake of the programme of measures.

It is planned that the action will involve two main tasks:

#### **Task 1: Establishment of logistical support facilities for the coordination of water table meetings**

A management framework will need to be established to ensure the smooth organisation of the water table meetings, with particular reference to the need of maintaining a regular link with the members of the water table. This will require the establishment of a technical coordination office (secretariat) which will be tasked with the management of the organisational aspects of the meetings as well as the necessary record associated with these meetings such as the drafting and circulation of meeting minutes. It is envisaged that this secretariat will be outsourced and the support required will be provided by external staff under contract.

#### **Task 2: Organisation of regular (quarterly) water table meetings**

The second task under the action will entail the organisation of the quarterly water table meetings, in which stakeholders will be updated on the progress in the implementation of identified measures under the 2<sup>nd</sup> RBMP. It is envisaged that the water table will be comprised of at least 17 representatives from both public and private stakeholders and will be chaired by a representative from EWA. Representation will be shared equally between public and private stakeholder representatives. Whilst the representatives of the identified public agencies will be nominated by their respective Ministry, the representative of the private stakeholder organisation will be selected following a public expression of interest for participation in this water table.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	Action C.17: Multi-stakeholder platform
Project Title:	BEWATER (Making society an active participant in water adaptation to global change)
Project Acronym/ID:	BEWATER/612385
Project Duration:	2013 – 2016
Project Status:	Completed
Funding Programme:	FP7-SIS
Key Contacts:	Contact Person 1: Name: Anabel Sánchez Email: <a href="mailto:a.sanchez@creaf.uab.cat">a.sanchez@creaf.uab.cat</a> Institution: Centre for Ecological Research and Forestry Applications (CREAF)
<u>Project Summary</u>  <p>The BeWater project, supported by the European Commission's 7th Framework Programme, offered a unique opportunity to contribute to adaptation policy design and practices with experience-based knowledge. Four research institutes located in the cardinal points of the Mediterranean region partnered with expert organisations and members of the local communities to elaborate local adaptive water management plans. Innovative approaches were developed within the project to facilitate a truly science-society collaborative process to increase societal resilience to climate variability and change at the river basin scale.</p> <p>The BeWater project provided innovative tools to facilitate the adaptation of river basins to global change via an active engagement of the local societies. The BeWater approach developed within the project focussed on creating a shared definition of what challenges needed to be targeted in the basin and then developing, assessing and prioritising a range of potential water management options to address these points along with pathways for their implementation. Four Mediterranean basins were part of the project, namely Pedieos (Cyprus), Vipava (Slovenia), Rmel (Tunisia) and Tordera (Catalonia, Spain). While each basin experienced the process slightly differently, all shared the common aim of introducing adaptation principles into water management at the river basin scale with stakeholder participation all along the process.</p>	

Adaptive management poses challenging questions that need to be tackled through methods and practices that have a solid theoretical framework but are still to be integrated into ordinary management procedures and policy design. Knowledge sharing and mutual learning between scientists, experts, decision-makers and local society have provided the needed basis for a truly participatory approach, offering a solid ground for capacity building, awareness raising and the development of concrete proposals in the form of adaptation plans for the four river basins. The process of co-production has proven to be able to deliver results with a high degree of social acceptance, political relevance and technical interest to tackle the uncertainties and complex nature of global change.

Throughout the design of the adaptation plans, common aspects, together with barriers and facilitators of their future implementation were observed. A handbook which provides guidelines on policy and practical considerations from the process was developed. The project may be considered as a strong reference for developing a participatory approach when designing river basin adaptation plans in other river basins, in Mediterranean countries and beyond.

Descriptive keywords:	'Awareness campaign' 'Adaptive management'
Project Website:	<a href="http://cordis.europa.eu/result/rcn/203169_en.html">http://cordis.europa.eu/result/rcn/203169_en.html</a> <a href="http://www.bewaterproject.eu/">http://www.bewaterproject.eu/</a>

#### Key Deliverables/Publications and Links

##### Adaptation Plans:

Vipava River Basin Adaptation Plan  
Tordera River Basin Adaptation Plan  
Rmel River Basin Adaptation Plan  
Pedieos River Basin Adaptation Plan

##### Handbook:

Developing Participatory Adaptation Plans for River Basins - a handbook

##### Policy Briefs:

Planning for climate change: Society as a key player in river basin adaptation

Policy recommendations for the EU level: Supporting participation in adaptive river basin management

Policy recommendations for the EU level: Recommendations for water management authorities within Europe and beyond

From planning to implementation: Recommendations for actions supporting adaptation in the Pedieos River Basin

From planning to implementation: Recommendations for actions supporting adaptation in the Vipava River Basin

From planning to implementation: Recommendations for implementation in the Rmel River Basin

From planning to implementation: Recommendations for action supporting adaptation in the Tordera River Basin

Deliverables – Reports:

D2.3 Guideline report on the BeWater approach outlining principles, methodology, concepts and protocols of the project

D3.1 Data integration in the Aquaknow platform

D4.1 - Compilation of best practice examples and experiences of adaptation plans

D4.2 Four draft adaptation plans, one for each CSRB

D4.3. Four River Basin Adaptation Plans

D5.2 Project Website

D6.1 EU/AU Policy Instruments Review

D6.2. 1st detailed cross-cutting Policy Sectors analysis -water and climate

D6.3 2nd Detailed Cross-cutting Policy Sectors Analysis - Water and Climate

D6.4 3rd detailed cross-cutting Policy Sectors analysis -water and climate

D.7.1 Study on national support mechanisms to international water management research

Dissemination material:

BeWater Brochure 2016

Publication in IMPACT Magazine

Relevant LIFE IP Concrete Action:	Action C.17: Multi-stakeholder platform
Project Title:	WeSenseIT: Citizen Observatory of Water
Project Acronym/ID:	WESENSEIT/308429
Project Duration:	01-10-2012 to 30-09-2016
Project Status:	Completed
Funding Programme:	FP7-ENVIRONMENT
Key Contacts:	Contact Person 1: Name: Joanne Watson Email/Telephone: +441142224754 Institution: The University of Sheffield
<u>Project Summary</u>	

WeSenseIt has developed a citizen-based observatory of water, which allowed citizens and communities to become active stakeholders in information capturing, evaluation and communication.

The following was proposed:

(i) Data collection:

(a) a first “hard” layer consisting of low-cost, static and portable devices that sense and transfer water information when automatically monitored or when initiated by citizens from their mobile devices;

(b) a second “soft” layer consisting of techniques designed to harness citizens’ Collective Intelligence, i.e. the information, experience and knowledge embodied within individuals and communities, which enabled both direct messages to the authorities (with mobile-phone pictures, messages, etc.) as well as crowd-sourcing (e.g. by mining social networks like Twitter and Facebook, as well as bulletin boards, RSS feeds, etc.).

(ii) The development of descriptive and predictive models and decision-making tools which integrated sensor and citizen-based data; the data suppliers (physical sensors or people) were seen as nodes of an integrated heterogeneous data collection network which had undergone progressive multi-objective optimisation and tuning.

(iii) Two-way feedback and exchange of environmental knowledge/experience between citizens and authorities for decision-making and governance within an e-collaboration framework, has improved transparency, knowledge management, accountability and responsiveness and facilitated participation in water management.

The citizen observatory of water was tested and demonstrated in three different case studies in water management with civil protection agencies in the United Kingdom, the Netherlands and Italy. The topic was the entire hydrologic cycle, with a major focus on variables responsible for floods and drought occurrences.

The project results had the potential to fundamentally change the traditional concept of environmental monitoring and forecasting, as well as models of governance.

Descriptive keywords:	‘Stakeholder involvement’ ‘Citizens active participants’
Project Website:	<a href="http://cordis.europa.eu/project/rcn/106532_en.html">http://cordis.europa.eu/project/rcn/106532_en.html</a>
<u>Key Deliverables/Publications and Links</u>	

Relevant LIFE IP Concrete Action:	Action C.17: Multi-stakeholder platform
Project Title:	Evaluating a Framework for Multi-Stakeholder Decision Support in Water Resources Management



Project Acronym/ID:	Not Applicable
Project Duration:	2001 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	<p>Contact Person 1: Name: RAIMO P. HÄMÄLÄINEN Email: <a href="mailto:raimo@hut.fi">raimo@hut.fi</a> Institution: Helsinki University of Technology</p> <p>Contact Person 2: Name: EERO KETTUNEN Email: <a href="mailto:eero.kettunen@hut.fi">eero.kettunen@hut.fi</a> Institution: Helsinki University of Technology</p> <p>Contact Person 3: Name: HARRI EHTAMO Email: <a href="mailto:eero.kettunen@hut.fi">eero.kettunen@hut.fi</a> Institution: Helsinki University of Technology</p> <p>Contact Person 4: Name: MIKA MARTTUNEN Email: <a href="mailto:mika.marttunen@vyh.fi">mika.marttunen@vyh.fi</a> Institution: Finnish Environment Institute</p>
<p><u>Project Summary</u></p> <p>This study involves the testing of a framework for multi-criteria modelling and support of multi-stakeholder decision processes within the context of developing a new water level management policy for a regulated lake river system in Finland.</p> <p>In this framework the stakeholders were involved in the decision process from the problem structuring stage to the group consensus seeking stage, followed by a stage of seeking public acceptance for the policy. The framework aimed at creating an evolutionary learning process. In this paper, focus was also on the use of a new interactive method for finding and identifying Pareto-optimal alternatives. Role playing experiments with students were used to test the practical applicability of a negotiation support procedure called the method of improving directions. The study has also developed a preference programming approach for the aggregation of the stakeholder opinions in the final evaluation of alternatives and group consensus seeking. This approach consists of individual prioritisations as well as group interval models and consensus seeking. In addition, the approach was previously studied in transport planning and nuclear power related settings.</p>	
Descriptive keywords:	'Group decision support' 'Multi-criteria decision modelling' 'Negotiation support' 'Water resources management'
Project Website:	
<u>Key Deliverables/Publications and Links</u>	

HÄMÄLÄINEN, R., KETTUNEN, E., EHTAMO, H. and MARTTUNEN, M. (2001). Evaluating a Framework for Multi-Stakeholder Decision Support in Water Resources Management. *Group Decision and Negotiation*, [online] 10(331–353). Available at: [http://ftp://193.2.92.44/students/podipl/UVR/Hamalainen\\_et\\_al\\_2001.pdf](http://ftp://193.2.92.44/students/podipl/UVR/Hamalainen_et_al_2001.pdf) [Accessed 31 Jan. 2018].

Relevant LIFE IP Concrete Action:	Action C.17: Multi-stakeholder platform
Project Title:	Social Learning: The Key to Integrated Water Resources Management?
Project Acronym/ID:	Not Applicable
Project Duration:	2008 (Date Published)
Project Status:	Completed
Funding Programme:	Not Applicable
Key Contacts:	Authors: E. Mostert, M. Craps and C. Pahl-Wostl
<u>Project Summary</u>  <p>This article discussed social learning as a means to implement integrated water resources management (IWRM). Implementing IWRM requires cooperation between policy sectors, countries, government bodies, the civic sector and scientific disciplines. The social learning approach suggests several ingredients for such cooperation. The article discusses how water managers and the other stakeholders need to realise their dependence on each other for reaching their own goals, before they start interacting, sharing their problem perceptions and developing different potential solutions. It also highlights that to achieve such results, the development of mutual trust, recognition of diversity and critical self-reflection is required amongst water managers and stakeholders. However, stakeholders must take joint decisions and make the necessary arrangements for implementation. The social learning approach to IWRM had several implications for the IWRM ToolBox of the GWP. Social learning is not a magic solution for all problems, but there is sufficient evidence that it can work.</p>	
Descriptive keywords:	‘Integrated water resources management’ ‘Social learning’ ‘Cooperation’ ‘Trans-boundary’
Project Website:	Not Applicable
<u>Key Deliverables/Publications and Links</u>  <p>Mostert, E., Craps, M. and Pahl-Wostl, C. (2008). Social learning: the key to integrated water resources management?. <i>Water International</i>, [online] 33(3), pp.293-304. Available at: <a href="https://lirias.kuleuven.be/bitstream/123456789/408705/1/Mostert,+Craps+%26+Pahl+(2006)+SL+key+to+IWRM.pdf">https://lirias.kuleuven.be/bitstream/123456789/408705/1/Mostert,+Craps+%26+Pahl+(2006)+SL+key+to+IWRM.pdf</a> [Accessed 31 Jan. 2018].</p>	

Relevant LIFE IP Concrete Action:

Action C.17: Multi-stakeholder platform

Project Title:	Sustainable domestic Water Use in Mediterranean Regions
Project Acronym/ID:	SWMED
Project Duration:	2011 - 2014
Project Status:	Completed
Funding Programme:	2007 - 2013 Mediterranean Sea Basin ENPI CBC
Key Contacts:	Contact Person 1: Name: Not Available Email: <a href="mailto:adrago@regione.lazio.it">adrago@regione.lazio.it</a> Institution: Region of Latium
<p><u>Project Summary</u></p> <p>The whole Mediterranean area is characterised by a strong need of new solutions able to provide sanitation services while reducing water use and wastewater discharge. The SWMED project focuses on optimising the per capita water consumption at household and urban level through the implementation of water saving devices, reuse of treated wastewater, rainwater harvesting, and a pool of technologies collectively known as Sustainable Water Management (SWM). In order to achieve the desired results, the project has gathered together stakeholders from different fields.</p> <p>The achieved results were the following:</p> <ul style="list-style-type: none"> <li>• A discussion about National/local “water tables” gathering all water stakeholders;</li> <li>• The development of a SWM tailor-made solution database for different settlement typologies to be applied in water policy;</li> <li>• A water policy paper agreed upon by all relevant stakeholders;</li> <li>• Dissemination of the project results to different groups (citizens, technicians, water authorities, etc.).</li> </ul>	
Descriptive keywords:	‘Water management’ ‘New products and services’ ‘Sustainable management of natural resources’
Project Website:	Not available
<p><u>Key Deliverables/Publications and Links</u></p> <p><a href="https://www.keep.eu/keep/project-ext/10834/SWMED?ss=3d3626826ba7d857bdc4d38ea697aef2&amp;espon">https://www.keep.eu/keep/project-ext/10834/SWMED?ss=3d3626826ba7d857bdc4d38ea697aef2&amp;espon</a></p>	

## Action C.18: Monitoring for emerging pollutants of potential concern

### Brief Description of the Concrete Action

The Environment and Resources Authority shall be in charge of coordinating the implementation of this action.

The term Emerging Pollutants primarily refers to those compounds for which no regulations currently require monitoring or public reporting of their presence in surface waters or groundwaters. “Emerging pollutants” can be defined as pollutants that are currently not included in routine monitoring programmes at European level and which may be candidates for future regulation, depending on research on their (eco)toxicity, potential health effects and public perception and on monitoring data regarding their occurrence in various environments. Over 700 compounds have been included in the NORMAN List of Emerging Substances, NORMAN being a network of reference laboratories, research centres and related organisations for the monitoring of emerging environmental substances. These substances are suspected of causing adverse effects in humans and wildlife (PBT – persistence, bioaccumulation and toxicity).

The implementation process of this action will entail the undertaking of an investigative monitoring exercise based on the monitoring strategy developed under Action A.1. This will entail screening with replicates of all identified substances over a 2-year period in the 4 identified water categories. Monitoring results pertaining to each water category every year will be presented in annual reports. The detection of any indicator parameter at levels which could be of potential concern will then lead to focused monitoring of the particular contaminant during the third year. This monitoring exercise will commence in 2020. Any potential contaminants of concerns shall be monitored for a third time in 2022.

### Related Research Initiatives

Relevant LIFE IP Concrete Action:	C.18 - Monitoring for emerging pollutants of potential concern
Project Title:	Innovative biodiagnosis meets chemical structure elucidation – Novel tools in effect directed analysis to support the identification and monitoring of emerging toxicants on a European scale
Project Acronym/ID:	EDA-EMERGE
Project Duration:	2011-2015
Project Status:	Completed
Funding Programme:	FP7 – PEOPLE-2011-ITN  Funding scheme – MC-ITN- Networks for Initial Training (ITN)
Key Contacts:	<u>Coordinator</u> HELMHOLTZ  <u>Administrative contact</u> Annette Schmidt

	<p>Tel.: +49 341 235 1663 Fax: +49 341 235 1386</p> <p><u>Email</u> <a href="http://cordis.europa.eu/mailanon/form_en?address=QWlt140tylZd4O7-an5Ug1MUXJLQ6R1xD31_ap7qtl%2C&amp;name=Ms.+Annette+Schmidt">http://cordis.europa.eu/mailanon/form_en?address=QWlt140tylZd4O7-an5Ug1MUXJLQ6R1xD31_ap7qtl%2C&amp;name=Ms.+Annette+Schmidt</a></p> <p><u>Institution</u> Zentrum fuer umweltforschung GMBH Permoser Strasse 15 04318 Leipzig, Germany</p>
<p><u>Project Summary</u></p> <p>EDA-EMERGE aims to train a new generation of young scientists in the interdisciplinary techniques required to meet the major challenges in the monitoring, assessment and management of toxic pollution in European river basins considering the enormous complexity of contamination, effects and cause-effect relationships. By integrating innovative mode-of-action based biodiagnostic tools including in vitro tests, transgenic organisms and “omics” techniques with powerful fractionation and cutting edge analytical and computational structure elucidation tools, a new generation of effect directed analysis (EDA) approaches will be developed for the identification of toxicants in European surface and drinking waters. Innovative method development by young researchers at major universities, research centres and private companies will be closely interlinked with a joint European demonstration program and higher tier EDA and extensive training courses. EDA-EMERGE ESRs will learn to organise and run international and interdisciplinary sampling and monitoring campaigns and benefit from the expertise of one of the most experienced private companies in this field. Strong networking between academia, the private sector and leading regulators in the field of river basin management and pollution management ensures the relevance of the research for practice and excellent employment opportunities for EDA-EMERGE ESRs. The combination of cutting edge science with training in multiple complementary (soft) skills offered with a strong emphasis on commercial exploitation and media competence will further enhance employability of well-trained ESRs not only in research and academia but far beyond. An internationally composed advisory board will introduce new perspectives of monitoring, assessment and management of emerging pollutants within and outside of Europe.</p>	
Descriptive keywords:	Emerging toxicants, pollutants, monitoring, research, surface water, river basins
Project Website:	<a href="http://www.eda-emerge.eu/">http://www.eda-emerge.eu/</a>
<p><u>Key Deliverables/Publications and Links</u></p> <p>Result in Brief – New solutions for water pollution - <a href="http://cordis.europa.eu/result/rcn/151550_en.html">http://cordis.europa.eu/result/rcn/151550_en.html</a></p> <p>EDA-EMERGE Report Summary - <a href="http://cordis.europa.eu/result/rcn/184180_en.html">http://cordis.europa.eu/result/rcn/184180_en.html</a></p> <p>Open access publications – <a href="http://publications.rwth-aachen.de/record/673445">http://publications.rwth-aachen.de/record/673445</a> <a href="http://archimer.ifremer.fr/doc/00347/45846/45498.pdf">http://archimer.ifremer.fr/doc/00347/45846/45498.pdf</a></p>	

Relevant LIFE IP Concrete Action:	C.18 - Monitoring for emerging pollutants of potential concern
Project Title:	Solutions for present and future emerging pollutants in land and water resources management
Project Acronym/ID:	SOLUTIONS
Project Duration:	2013-2018
Project Status:	Ongoing (to be finalised in 2018)
Funding Programme:	FP7 – ENV-2013-two-stage  Funding scheme – CP – Collaborative project (generic)
Key Contacts:	<u>Coordinator</u> HELMHOLTZ  <u>Administrative contact</u> Annette Schmidt Tel.: +49 341 235 1663  <u>Email</u> <a href="http://cordis.europa.eu/project/rcn/110817_en.html">http://cordis.europa.eu/project/rcn/110817_en.html</a>  <u>Institution</u> Zentrum fuer umweltforschung GMBH Permoser Strasse 15 04318 Leipzig, Germany
<u>Project Summary</u>  <p>SOLUTIONS will deliver a conceptual framework for the evidence-based development of environmental and water policies. This will integrate innovative chemical and effect-based monitoring tools with a full set of exposure, effect and risk models and assessment options. Uniquely, SOLUTIONS taps (i) expertise of leading European scientists of major FP6/FP7 projects on chemicals in the water cycle, (ii) access to the infrastructure necessary to investigate the large basins of Danube and Rhine as well as relevant Mediterranean basins as case studies, and (iii) innovative approaches for stakeholder dialogue and support. In particular, International River Commissions, EC working groups and water works associations will be directly supported with consistent guidance for the early detection, identification, prioritization, and abatement of chemicals in the water cycle. A user-friendly tool providing access to a set of predictive models will support stakeholders to improve management decisions, benefiting from the wealth of data generated from monitoring and chemical registration. SOLUTIONS will give a specific focus on concepts and tools for the impact and risk assessment of complex mixtures of emerging pollutants, their metabolites and transformation products. Analytical and effect-based screening tools will be applied together with ecological assessment tools for the identification of toxicants and their impacts. Beyond state-of-the-art monitoring and management tools will be elaborated allowing risk identification for aquatic ecosystems and human health. The SOLUTIONS approach will provide</p>	

transparent and evidence-based lists of River Basin Specific Pollutants for the case study basins and support the review of the list of WFD priority pollutants.	
Descriptive keywords:	Emerging pollutants, priority pollutants, research, surface water, aquatic ecosystems, monitoring, tools, river basins
Project Website:	<a href="http://www.solutions-project.eu/">http://www.solutions-project.eu/</a>
<u>Key Deliverables/Publications and Links</u>  Report Summaries – <a href="http://cordis.europa.eu/result/rcn/171679_en.html">http://cordis.europa.eu/result/rcn/171679_en.html</a> <a href="http://cordis.europa.eu/result/rcn/197191_en.html">http://cordis.europa.eu/result/rcn/197191_en.html</a>  Open access publications – <a href="http://europepmc.org/articles/PMC5571148">http://europepmc.org/articles/PMC5571148</a> <a href="http://europepmc.org/articles/PMC5136570">http://europepmc.org/articles/PMC5136570</a> <a href="http://europepmc.org/articles/PMC4732001">http://europepmc.org/articles/PMC4732001</a>	

Relevant LIFE IP Concrete Action:	C.18 - Monitoring for emerging pollutants of potential concern
Project Title:	Demonstration of promising technologies to address emerging pollutants in water and waste water
Project Acronym/ID:	DEMEAU
Project Duration:	2012-2015
Project Status:	Completed
Funding Programme:	FP7 – ENV-2012-two-stage  Funding scheme – CP – Collaborative project (generic)
Key Contacts:	<u>Coordinator</u> KWR WATER B.V.  <u>Administrative contact</u> Theo Van Den Hoven Tel: +31 30 60 69 535  <u>Email</u> <a href="http://cordis.europa.eu/project/rcn/105612_en.html">http://cordis.europa.eu/project/rcn/105612_en.html</a>  <u>Institution</u> Groningenhaven 7 3433 Nieuwegein Netherlands

Project Summary

The water and waste water sectors are facing tremendous challenges to assure safe, cost-effective and sustainable water supply and sanitation services. DEMEAU promotes the uptake of knowledge, prototypes and practices from previous EU research enabling the water cycle sector to face emerging pollutants and thus securing water and waste water services and public health. The project exploits four groups of promising technologies from previous EU research: Managed Aquifer Recharge (MAR), hybrid ceramic membrane filtration, hybrid advanced oxidation processes, bioassays. Exploitation takes place through action research with universities, research institutions, innovative SME's, launching water utilities and policy makers.

Essential in the DEMEAU approach is the cooperation with water utilities that have committed to act as launching customer for the selected technologies. Existing and improved performance assessment methodologies will be used to benchmark the novel technologies against existing ones. This is to demonstrate the suitability and cost-effectiveness of the demonstrated technologies. Demonstration sites at launching utilities act as transfer points for the technologies and will generate market opportunities for the SME's involved.

To foster a broader impact and market penetration of the technologies, DEMEAU seeks cooperation with relevant policy makers, regulators and standardization bodies on Member State and European level in order to address barriers and promoters for the implementation. A considerable percentage (39%) of the total requested EC contribution is allocated to SME's.

Descriptive keywords:	Emerging pollutants, technologies, wastewater, surface water
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Project Website:	<a href="http://demeau-fp7.eu/">http://demeau-fp7.eu/</a>
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Key Deliverables/Publications and Links

Result in Brief –

[http://cordis.europa.eu/result/rcn/159932\\_en.html](http://cordis.europa.eu/result/rcn/159932_en.html)

Report Summaries –

[http://cordis.europa.eu/result/rcn/182187\\_en.html](http://cordis.europa.eu/result/rcn/182187_en.html)

Final Report –

<http://cordis.europa.eu/docs/results/308/308339/final1-20160229-demeau-final-report.pdf>

Relevant LIFE IP Concrete Action:	C.18 - Monitoring for emerging pollutants of potential concern
Project Title:	Emerging contaminants in groundwater
Project Acronym/ID:	Not available
Project Duration:	Paper published in 2011
Project Status:	Completed



Funding Programme:	British Groundwater Science Programme
Key Contacts:	<u>Institution</u> Natural Environment Research Council Polaris House, North Star Avenue Swindon, SN2 1EU United Kingdom Tel. 01793 411500 Fax. 01793 411501

### Project Summary

The term 'emerging contaminants' is generally used to refer to compounds previously not considered or known to be significant to groundwater (in terms of distribution and/or concentration) which are now being more widely detected. As analytical techniques improve, previously undetected organic micropollutants are being observed in the aqueous environment. Many emerging contaminants remain unregulated, but the number of regulated contaminants will continue to grow slowly over the next several decades. There is a wide variety of sources and pathways for these compounds to enter the environment and these include agriculture and urban areas. Some of these contaminants can have human or ecological health effects and there is a need for better understanding of their fate in environmental systems. This report provides a short review of the types of organic micropollutants which can be found in the aqueous environment. These include nanomaterials, pesticides, pharmaceuticals, industrial additives and by-products, personal care products and fragrances, water treatment by-products, flame/fire retardants and surfactants, as well as caffeine and nicotine metabolites and hormones. Many of the compounds are relatively small polar molecules which are not effectively removed by conventional drinking water treatment using activated carbon. Pesticides and some industrial compounds are presently covered by the Water Framework Directive, the Groundwater Regulations and the Drinking Water Directive. Additional parameters, such as bisphenol A and nonyl-phenol are anticipated to be covered by revisions to the Drinking Water Directive. Others are currently unregulated. In order to assess the hazards presented by such compounds, information on usage, persistence, leachability and a robust sensitive analytical method is required. The UK metaldehyde problem was not originally discovered due to lack of an analytical method and was exacerbated by recalcitrance in water treatment. For many pesticides these requirements are fulfilled and an assessment of risk of leaching to groundwater can be made. However, for pesticide metabolites this information can be sparse and for compounds such as pharmaceuticals it can be lacking. A simple hazard assessment for currently approved pesticides was made from information on UK usage, persistence, sorption to soil carbon and published leaching indices. The following compounds were assessed as having the greatest potential for leaching to water: 2,4-D, amidosulfuron, bentazone, clopyralid, dicamba, florasulam, fosthiazate, imazaquin, iodosulfuron-methyl-sodium, maleic hydrazide, MCPA, MCPP-P, metribuzin, metsulfuronmethyl, quinmerac, oxamyl, and triclopyr with a further 46 also having potential. Of these, 19 had an octanol/water partition coefficient ( $K_{ow}$ ) less than that of metaldehyde and therefore are likely to be incompletely removed by water treatment. A simple assessment for pesticide metabolites, based only on organic carbon/water partition coefficient ( $K_{oc}$ ) and persistence data, in this study gave results which agreed in principle with other studies. The different approaches indicate that the metabolites of chlorothalonil, cyanazine, diflufenican, flufenacet, iodosulfuron-methyl, metaldehyde, metazachlor and metsulfuron-methyl are likely to pose the greatest risk to drinking water. In many cases these metabolites are derived from parents which have a lesser risk. Other organic micropollutants, such as pharmaceuticals, cannot as yet be assessed in the same way due to a lack of persistence data since the majority of persistence studies have been directed at water treatment. A range of organic micropollutants from urban settings have been

detected in ground and surface water. Commonly detected compounds include: bisphenol A, OR/11/013 viii carbamazepine, galaxolide, ibuprofen, iopamidol, phthalates, phenyl ethoxylates, and sulfamethoxazole. Case studies show that a small number of contaminants may be used to characterise the contaminant loading and also be used to assess the migration pathways in urban areas. Data interpreted by BGS from the Environment Agency's monitoring programme for organic pollutants indicates that the 30 most frequently detected compounds comprise both established and emerging compounds and include a number of polyaromatic hydrocarbons, petroleum compounds, triazine herbicides, chlorinated solvents, degradation products and THMs, caffeine, DEET and industrial compounds such as bisphenol A and tributyl phosphate. Specific determinands include a range of currently licensed and phased out pesticides with a few metabolites, pharmaceuticals including carbamazepine and triclosan, caffeine, nicotine and food additives and alkyl phosphates. These data exhibit hot spots which may indicate possible research areas. Future research should focus on a compound identified in the literature and detected by Environment Agency monitoring. Possible topics could be a study of migration through the unsaturated zone. In many cases the mechanism for migration of emerging contaminants from the surface to groundwater is very unclear.

Descriptive keywords:	Emerging pollutants, groundwater, organic micropollutants, pesticides, pharmaceuticals
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Project Website:	Not available
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#### Key Deliverables/Publications and Links

Final report –  
<http://nora.nerc.ac.uk/id/eprint/14557/1/OR11013.pdf>

Relevant LIFE IP Concrete Action:	C.18 - Monitoring for emerging pollutants of potential concern
Project Title:	Emerging Risks of Chemicals in the Environment
Project Acronym/ID:	Not available
Project Duration:	2018 - present
Project Status:	Ongoing
Funding Programme:	Natural Environment Research Council
Key Contacts:	<u>Programme Manager (Research)</u> James Box 07928 525444  <u>Institution</u> Natural Environment Research Council Polaris House, North Star Avenue Swindon, SN2 1EU

	<p>United Kingdom Tel.: 01793 411500 Fax: 01793 411501</p> <p><u>Email</u> chemicals@nerc.ac.uk</p>
<p><u>Project Summary</u></p> <p>The Emerging Risks of Chemicals in the Environment programme aims to conduct research to predict how the environment and its functioning will respond to chemical exposure. The anticipated high-level outcome is a transformation in the way chemical risk assessment is considered; to move towards an ecosystems approach with greater ecological relevance.</p> <p>There are many tens of thousands of chemicals that we use in our homes, industries and food systems and the market is growing by about 2,000 new compounds per year. Chemical use is dynamic; looking to the future, the changing demographics of a globally rising population (and, in developed countries, an increasingly ageing and medicated population) will lead to more drugs discharged through the water systems; changing agricultural practices, energy and material needs are likely to lead to new effluents and pressures; new pest and disease pressures and increasing resistance to products will alter use of agrochemical and veterinary products; green chemistry has the potential to drive the development of novel chemistries in the future; and a focus on recycling and reuse will change how we use products and manage waste streams.</p> <p>The persistence and fate of chemicals entering the environment are controlled by complex interactions with natural processes. Ecosystems are exposed to combinations of chemical mixtures and other environmental stressors and environmental changes. The potential impacts of exposure on individual organisms has been the focus of considerable research, yet understanding of dynamic, complex and long-term exposure and the outcomes and implications for critical ecosystems and the services they provide, remain uncertain and difficult to predict.</p> <p>Furthermore, there is ongoing loss of biodiversity and other evidence for environmental degradation and it is not known what contribution chemicals make towards this. Human exposure to chemicals via the environment (such as through drinking water or the food chain) can result in unpredicted but important impacts, and appreciation of compounds to which humans are sensitive is important when trying to understand and manage chemicals in the environment.</p> <p>This research programme will deliver fundamental process understanding underpinning chemical behaviour and impact in the environment and a predictive capability to support chemicals management, in three interlinked research questions:</p> <ol style="list-style-type: none"> <li>i. What are the impacts of chemicals on populations, ecosystems and ecosystem services?</li> <li>ii. What are the risks from chemical mixtures?</li> <li>iii. How important are chemical stressors in relation to other stressors?</li> </ol>	
Descriptive keywords:	Emerging pollutants, groundwater, organic micropollutants, pesticides, pharmaceuticals
Project Website:	<a href="http://www.nerc.ac.uk/research/funded/programmes/chemicals/">http://www.nerc.ac.uk/research/funded/programmes/chemicals/</a>
<u>Key Deliverables/Publications and Links</u>	

Chemicals in the Environment scoping workshop –  
<http://www.nerc.ac.uk/research/funded/programmes/chemicals/chemicals-workshop/>

Relevant LIFE IP Concrete Action:	C.18 - Monitoring for emerging pollutants of potential concern
Project Title:	Network of reference laboratories, research centres and related organisations for monitoring of emerging environmental substances
Project Acronym/ID:	NORMAN
Project Duration:	2005 – present
Project Status:	Ongoing
Funding Programme:	The NORMAN network started its activities in September 2005 with the financial support of the European Commission (NORMAN project - 6th Framework Programme – Priority 6.3 - Contract N° 018486). In 2009, the NORMAN network became a permanent self-sustaining network of reference laboratories, research centres and related organisations for the monitoring and biomonitoring of emerging environmental substances. It is established as a non-profit association of all interested stakeholders dealing with emerging substances. NORMAN has adopted its Statutes and Internal Regulations under the French law of 1901 on non-profit organisations.
Key Contacts:	<p><u>Executive Secretary of the NORMAN network</u> Ms. Valeria DULIO</p> <p><u>Email</u> <a href="mailto:valeria.dulio@ineris.fr">valeria.dulio@ineris.fr</a></p> <p><u>Institution</u> INERIS, Direction Scientifique Rue Jacques Taffanel – Parc Technologique ALATA F-60550 Verneuil-en-Halatte,</p>

#### Project Summary

Emerging environmental substances are not necessarily new chemicals. They are substances that have often long been present in the environment but whose presence and significance are only now being elucidated.

NORMAN has identified a list of the currently most frequently discussed emerging substances and emerging pollutants. These substances are selected by the NORMAN Prioritisation Working Group, based on citations in the scientific literature, and taking into account the definition of "emerging substances" and "emerging pollutants" given in the NORMAN Glossary of terms.

NORMAN systematically collects in the EMPODAT database monitoring data and information on effects and hazardous properties for these substances. On the basis of this information, the substances are assigned to priority action categories by the NORMAN Prioritisation Working Group.

"Emerging substances" can be defined as substances that have been detected in the environment, but which are currently not included in routine monitoring programmes at EU level and whose fate, behaviour and (eco)toxicological effects are not well understood.

"Emerging pollutants" can be defined as pollutants that are currently not included in routine monitoring programmes at the European level and which may be candidates for future regulation, depending on research on their (eco)toxicity, potential health effects and public perception and on monitoring data regarding their occurrence in the various environmental compartments.

Examples from the LIST OF EMERGING SUBSTANCES are surfactants, flame retardants, pharmaceuticals and personal care products, gasoline additives and their degradation products, biocides, polar pesticides and their degradation products and various proven or suspected endocrine disrupting compounds (EDCs). The NORMAN experts regularly revise the list of emerging substances.

Descriptive keywords:	Emerging substances, pollutants, laboratories, prioritisation
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Project Website:	<a href="http://www.norman-network.net/?q=Home">http://www.norman-network.net/?q=Home</a>
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#### Key Deliverables/Publications and Links

Working Groups –

<http://www.norman-network.net/?q=Working%20Groups>

Success stories –

<http://www.norman-network.net/?q=Success%20Stories>

Publications –

<http://www.norman-network.net/?q=Publications>

Topics and activities –

<http://www.norman-network.net/?q=node/15>

Workshops and events –

<http://www.norman-network.net/?q=node/20>

Relevant LIFE IP Concrete Action:	C.18 - Monitoring for emerging pollutants of potential concern
Project Title:	Protecting Water Resources from Mobile Trace Chemicals
Project Acronym/ID:	PROMOTE
Project Duration:	2015 - 2017
Project Status:	Completed

Funding Programme:	2013 Water JPI Pilot Call
Key Contacts:	<p><u>Scientific executive officer</u>  Prof. Dr. Georg Teutsch  Phone ++49 341 235-1800  Fax ++ 49 341 235-1388</p> <p><u>Administrative executive officer</u>  Prof. Dr. Heike Graßmann  Phone ++49 341 235-1801  Fax ++ 49 341 235-1388  Email. <a href="mailto:heike.peters@ufz.de">heike.peters@ufz.de</a></p> <p><u>Institution</u>  Helmholtz Centre for Environmental Research – UFZ  Permoserstraße 15   04318 Leipzig, Germany  Phone +49 341 235-1269</p> <p><u>Email</u>  <a href="mailto:info@ufz.de">info@ufz.de</a></p>
<p><u>Project Summary</u></p> <p>Drinking water quality is potentially threatened by the release of chemicals that we are producing and using. If these chemicals are water soluble and poorly degradable or if poorly degradable and polar transformation products are formed from them, then these chemicals may specifically be of concern.</p> <p>PROMOTE focuses on persistent, mobile organic contaminants (PMOC). PMOC are highly polar compounds and as such likely to occur in the water cycle and in raw waters used for drinking water production. At the same time their physicochemical properties make them very challenging to analyze. Consequently, analytical methods are insufficiently developed and little is known upon their occurrence in environmental and drinking waters. PROMOTE follows two strategies to identify and monitor PMOC: (a) developing and applying analytical methods for screening of water samples for PMOC and (b) selection and prioritization of candidate substances based on REACH data and developing analytical methods for their quantitative analysis.</p> <p>The developed analytical methods will be applied to representative samples from five European river basins, to WWTP effluents, to groundwater samples and to raw waters used for drinking water production. For PMOC occurring in raw waters or likely to occur in such waters PROMOTE will study the potential of different drinking water treatment strategies to remove PMOC. PMOC will be prioritized in terms of their emission sources and removal options and adequate mitigation methods at reasonable effort will be proposed. This will include improved treatment processes for compounds emitted only locally, changes in the use profile and regulation within the REACH legislation. Widely distributed PMOC of environmental or health concern may also be candidates for the watch list of the WFD.</p>	

Descriptive keywords:	Emerging contaminants, trace pollutants, water resource, REACH, drinking water
Project Website:	<a href="http://www.promote-water.eu/">http://www.promote-water.eu/</a>
<p><u>Key Deliverables/Publications and Links</u></p> <p>Publications –</p> <p>Screening for polar chemicals in water by trifunctional mixed-mode liquid chromatography-high resolution mass spectrometry (2017) - <a href="http://pubs.acs.org/doi/abs/10.1021/acs.est.6b05135">http://pubs.acs.org/doi/abs/10.1021/acs.est.6b05135</a></p> <p>Ranking REACH registered neutral, ionizable and ionic organic chemicals based on their aquatic persistency and mobility (2017) - <a href="http://pubs.rsc.org/en/content/articlelanding/2017/em/c7em00158d#!divAbstract">http://pubs.rsc.org/en/content/articlelanding/2017/em/c7em00158d#!divAbstract</a></p> <p>Halogenated methanesulfonic acids: A new class of organic micropollutants in the water cycle (2016) - <a href="http://www.sciencedirect.com/science/article/pii/S0043135416304146">http://www.sciencedirect.com/science/article/pii/S0043135416304146</a></p> <p>Mind the gap: Persistent and mobile organic compounds – water contaminants that slip through (2016) - <a href="http://pubs.acs.org/doi/pdf/10.1021/acs.est.6b03338">http://pubs.acs.org/doi/pdf/10.1021/acs.est.6b03338</a></p> <p>Book Chapter -</p> <p>High-Resolution Mass Spectrometry Identification of Micropollutants Transformation Products Produced During Water Disinfection With Chlorine and Related Chemicals (2016) <a href="http://www.sciencedirect.com/science/article/pii/S0166526X16300071">http://www.sciencedirect.com/science/article/pii/S0166526X16300071</a></p> <p>Software tools -</p> <p>PREGA is a freeware tool for off-line optimization of HPLC separation, which is able to simplify method development in several chromatographic modes, including Reversed-Phase or Mixed-Mode HPLC - <a href="http://www.usc.es/gcqprega/index_archivos/prega.htm">http://www.usc.es/gcqprega/index_archivos/prega.htm</a></p> <p>Several posters – Results and Publications section on <a href="http://www.promote-water.eu/">http://www.promote-water.eu/</a></p>	