



A BRIGHTER FUTURE, WITH A LITTLE HELP FROM OUR NATURE

Green-blue infrastructure integration into the water sector



THE CHALLENGE

Today, more than ever before, we are facing challenges caused by water scarcity, floods and droughts as well as water pollution. Demand for both drinking and industrial water is growing as the global population is expanding and as we increasingly use it for energy and food production. We are well aware that this “blue gold” is irreplaceable and still, we do not invest enough to keep our water clean and manage it in a sustainable way.

Instead, we rely on grey infrastructure (like dams or levees) that destroys natural elements, pollutes the environment and costs large amounts of money. However, it may still not function effectively, like it did not in 2006 in CEE, when after an unusual long winter poorly constructed dikes and levees contributed to heavy floods. In order to prevent its negative effects on human health as well as on properties, while addressing challenges appropriately, we need to adopt sustainable solutions.

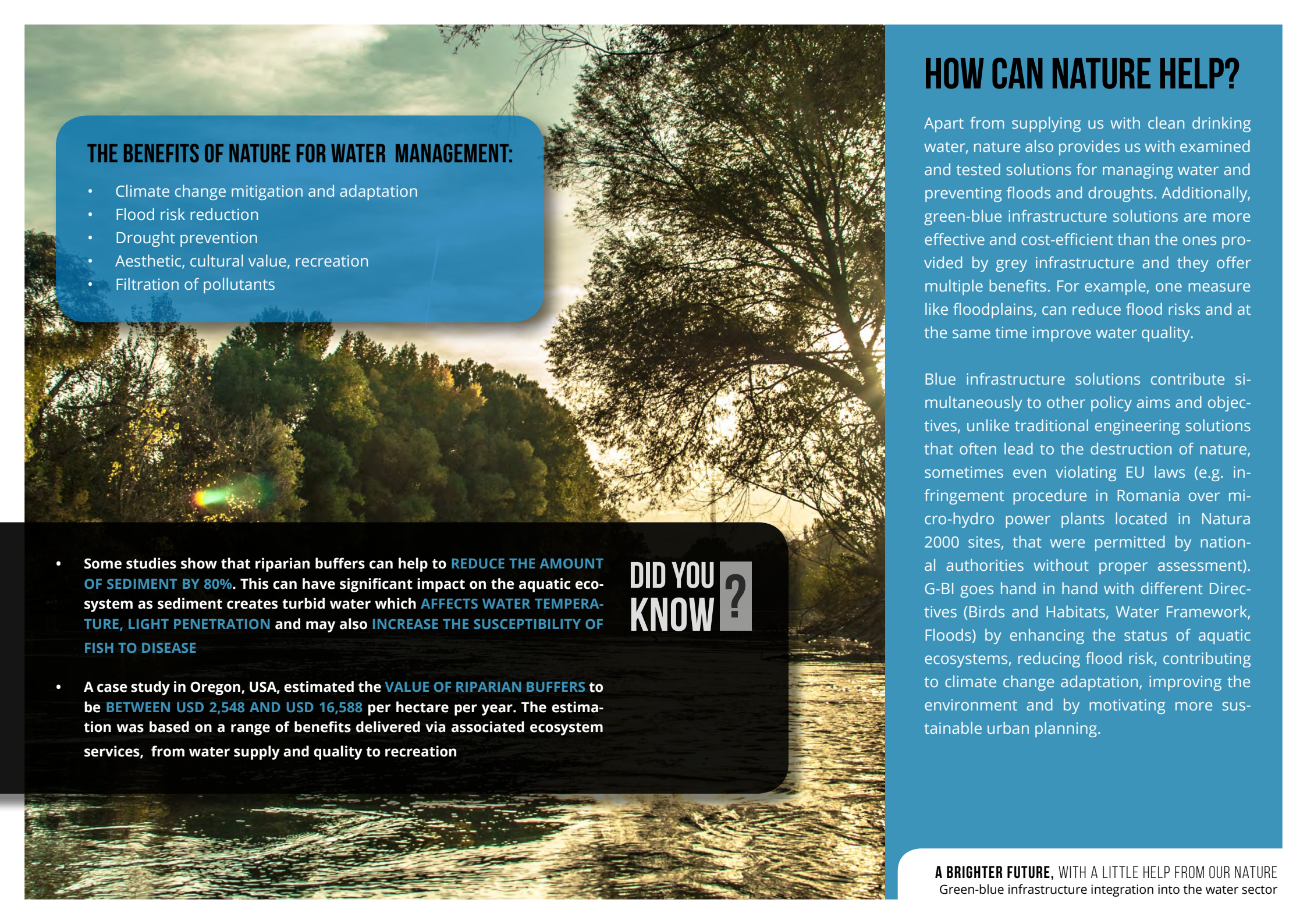
Shaping future water management in a sustainable way represents a challenge for all of us - ordinary people, experts and politicians alike. To prevent the consequences of inappropriate water management (effects on human health as well as on properties and the environment), we need to adopt sustainable solutions including employing green-blue infrastructure (G-BI).

DID YOU KNOW?

- Without adaptation, the number of people affected by **FLOODING** could become 7 times higher than it is today - up to 5.5 million people per year by 2085
- In 2003, the **DROUGHT** caused at least 8.7 billion EUR worth of damage to the European economy and the total cost of droughts over the past thirty years amounts to 100 billion EUR
- Populations of more than 300 **FRESHWATER SPECIES DECLINED** by around 55% in the period between 1970 and 2000, due to changes in shape, boundaries and content of water bodies



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THE BENEFITS OF NATURE FOR WATER MANAGEMENT:

- Climate change mitigation and adaptation
- Flood risk reduction
- Drought prevention
- Aesthetic, cultural value, recreation
- Filtration of pollutants

- Some studies show that riparian buffers can help to **REDUCE THE AMOUNT OF SEDIMENT BY 80%**. This can have significant impact on the aquatic ecosystem as sediment creates turbid water which **AFFECTS WATER TEMPERATURE, LIGHT PENETRATION** and may also **INCREASE THE SUSCEPTIBILITY OF FISH TO DISEASE**
- A case study in Oregon, USA, estimated the **VALUE OF RIPARIAN BUFFERS** to be **BETWEEN USD 2,548 AND USD 16,588** per hectare per year. The estimation was based on a range of benefits delivered via associated ecosystem services, from water supply and quality to recreation

**DID YOU
KNOW ?**

HOW CAN NATURE HELP?

Apart from supplying us with clean drinking water, nature also provides us with examined and tested solutions for managing water and preventing floods and droughts. Additionally, green-blue infrastructure solutions are more effective and cost-efficient than the ones provided by grey infrastructure and they offer multiple benefits. For example, one measure like floodplains, can reduce flood risks and at the same time improve water quality.

Blue infrastructure solutions contribute simultaneously to other policy aims and objectives, unlike traditional engineering solutions that often lead to the destruction of nature, sometimes even violating EU laws (e.g. infringement procedure in Romania over micro-hydro power plants located in Natura 2000 sites, that were permitted by national authorities without proper assessment). G-BI goes hand in hand with different Directives (Birds and Habitats, Water Framework, Floods) by enhancing the status of aquatic ecosystems, reducing flood risk, contributing to climate change adaptation, improving the environment and by motivating more sustainable urban planning.

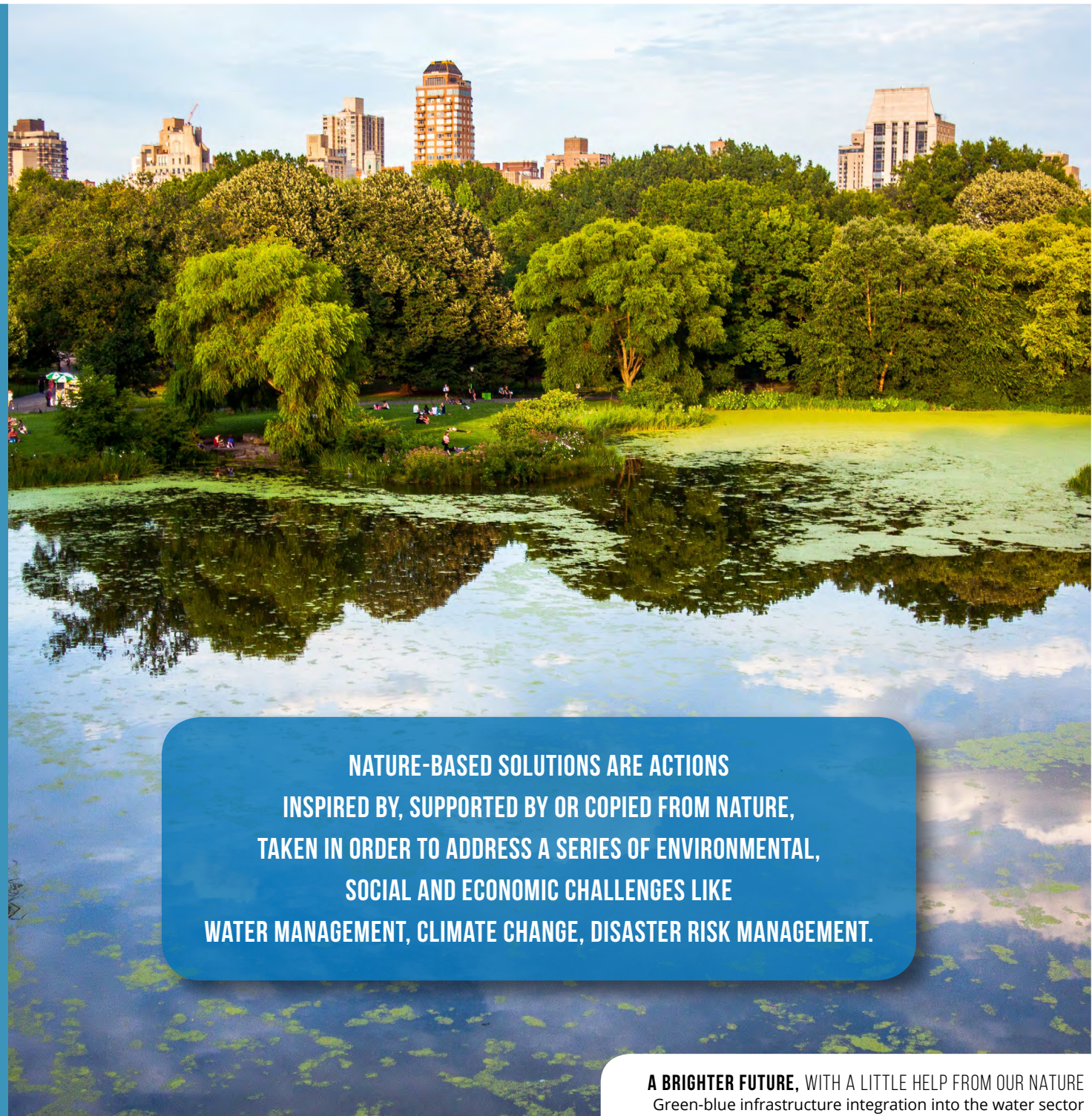
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WHAT IS GREEN-BLUE INFRASTRUCTURE?

It is a network of green and blue spaces that provides multiple significant benefits both for people and nature.

Tree lines, woodlands, polders, oxbows and other green and blue spaces (or “green-blue infrastructure elements”) have always been around us, and are now getting more and more popular as the growing urban population is seeking to reconnect with nature. They are present both in urban and rural settings and can range from small-scale urban spaces such as indoor rain gardens, permeable pavements, and green roofs to very large areas like nature reserves, floodplains and extended riparian forests. These solutions can have various names, such as “room for the river”, “natural water retention measures”, “nature-based solutions” and similar, while still having the very same goal - a sustainable use and preservation of nature.

Moreover, the added value of green and blue infrastructure is in putting these elements together into a network in order to enhance their connectivity and strengthen the multiple benefits for nature and society. It also enables the creation of a framework for a more structured approach to the management of those benefits.



**NATURE-BASED SOLUTIONS ARE ACTIONS
INSPIRED BY, SUPPORTED BY OR COPIED FROM NATURE,
TAKEN IN ORDER TO ADDRESS A SERIES OF ENVIRONMENTAL,
SOCIAL AND ECONOMIC CHALLENGES LIKE
WATER MANAGEMENT, CLIMATE CHANGE, DISASTER RISK MANAGEMENT.**

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LINK BETWEEN NATURE, WATER AND GREEN-BLUE INFRASTRUCTURE:

The natural environment is fundamental for human health – green and blue infrastructure provides a structure of the natural environment that ensures benefits both for people and nature - the benefits provided by the green and blue infrastructure network are reflected in improved health and safety conditions of the human population.

The Natura 2000 network currently covers almost 20% of EU territory, including many rivers, their basins and wetlands. The aim of the network is to achieve Favourable Conservation Status for species and habitats protected and therefore it goes hand in hand with the main objective of the Water Framework Directive (WFD) - to achieve good ecological status of all surface and ground waters. G-BI solutions are making these aims easier to achieve.

DID YOU KNOW?

- **GREEN ROOFS** can reduce the annual roof stormwater runoff by up to 50 to 60% through retention of up to 90 per cent of runoff from smaller storms (up to 25mm), and at least 30 per cent from large storms
- Every mile of **CONTINUOUS WETLANDS** is believed to reduce storm surge by 8 to 20 cm
- **INSTALLING PERMEABLE PAVEMENT** can reduce storm runoff by 70 to 90 per cent, reducing risk of flooding and overflow of sewage systems



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TAB. 1. ADAPTED FROM STROSSER, ET.AL. (2015) A GUIDE TO SUPPORT THE SELECTION, DESIGN AND IMPLEMENTATION OF NATURAL WATER RETENTION MEASURES IN EUROPE - CAPTURING THE MULTIPLE BENEFITS OF NATURE-BASED SOLUTIONS

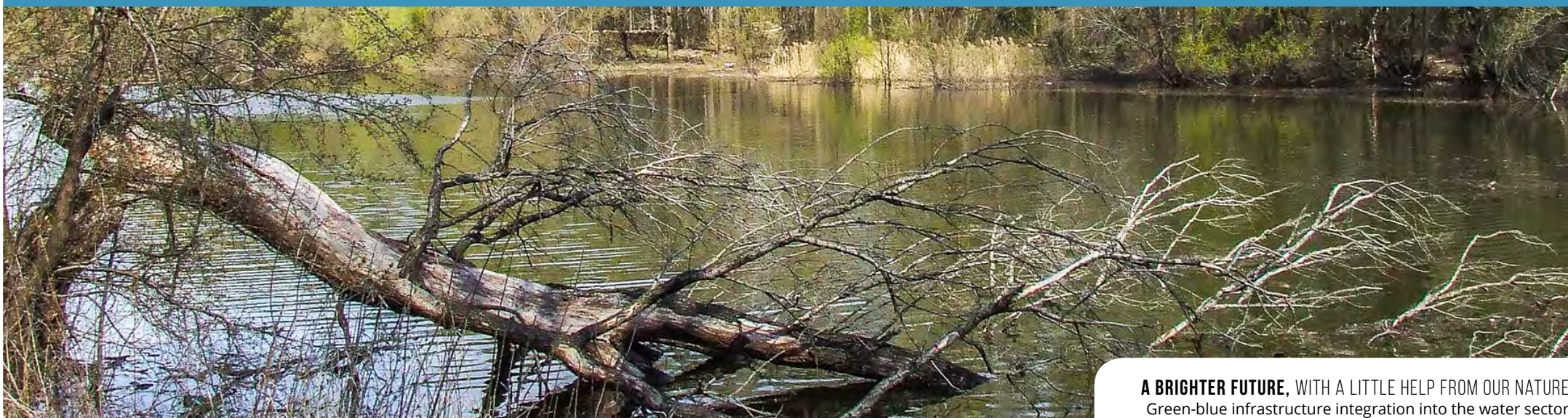
WORKING WITH NATURAL WATER RETENTION MEASURES (NWRM) HELPS YOU ACHIEVE OTHER OBLIGATIONS:

EU POLICY / RELATED DOCUMENT	EXPLICIT AND IMPLICIT LINKS TO NWRM OR SIMILAR
Water Framework Directive (Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000)	Annex VI provides a list of measures that can be considered in the Programmes of Measures, including i.a. 'recreation and restoration of wetland areas'. EU Water Blueprint (A Blueprint to Safeguard Europe's Water Resources COM/2012/0673 final) Promotes alternative land use practices for contributing to the achievement of WFD good ecological status, making specific references to NWRM. In particular, it states the following: "Among the measures that can greatly contribute to limiting the negative effects of floods and droughts is green infrastructure, particularly NWRM. These include restoring floodplains and wetlands which can hold water in periods of abundant — or excessive — precipitation for use in periods of scarcity. Green infrastructure can help ensure the provision of ecosystem services in line with the EU Biodiversity Strategy. Reducing soil sealing is another measure that can diminish flood risks. These measures should be included in both RBMPs and FRMPs and, as mentioned, should become a priority for financing under the Common Agricultural Policy (CAP), Cohesion and Structural Funds."
Floods Directive (Directive 2007/60/EC on the assessment and management of flood risks)	Article 7 specifies that flood risk management plans may also include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding of certain areas in the case of a flood event.
Disaster Risk Reduction (COMMISSION STAFF WORKING DOCUMENT Action Plan on the Sendai Framework for Disaster Risk Reduction 2015-2030 A disaster risk-informed approach for all EU policies SWD(2016) 205 final/2)	The document addresses green infrastructure and ecosystem based approaches as solutions to boost disaster resilience. One of the activities consists of developing guidance on green infrastructure, ecosystem based adaptation and disaster risk reduction by 2017.
Climate Change Adaptation Strategy (An EU Strategy on Adaptation to Climate Change, COM (2013) 216)	The strategy calls for a strong emphasis on incorporating win-win, low-cost and no-regret adaptation options. These include sustainable water management.



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EU POLICY / RELATED DOCUMENT	EXPLICIT AND IMPLICIT LINKS TO NWRM OR SIMILAR
Green Infrastructure Strategy (Green Infrastructure (GI) – Enhancing Europe’s natural capital, Com (2013) 249 final)	The strategy calls for using GI solutions instead of grey infrastructure, protecting natural capital and using it in a sustainable way. It also refers to Blue Infrastructure solutions: “The impacts of such [extreme weather] events on human society and the environment can often be reduced using GI solutions such as functional flood plains, riparian woodland, protection forests in mountainous areas, barrier beaches and coastal wetlands that can be made in combination with infrastructure for disaster reduction, such as river protection works.”
Common Agricultural Policy (The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future. COM(2010) 672 final)	CAP ‘greening’ measures include crop diversification, maintaining permanent grassland and dedicating a certain percentage of land to ecological focus areas, which include buffer zones, management of riparian woody vegetation, and keeping arable peaty or wet soils under grass.
Rural Development Regulation (RDR) (Regulation (Eu) No 1305/2013 Of The European Parliament And Of The Council of 17 December 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005)	Water retention is an implicit objective in the EU’s priorities for rural development. Article 5 of Regulation 1305/2013 refers to restoring, preserving and enhancing ecosystems related to agriculture and forestry, with a focus on the following areas: a) restoring, preserving and enhancing biodiversity, including in Natura 2000 areas, and in areas facing natural or other specific constraints, and high nature value farming, as well as the state of European landscapes; b) improving water management, including fertiliser and pesticide management; c) preventing soil erosion and improving soil management.
Birds Directive (Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds)	One of the core priorities of the Birds Directive is to restore a sufficient diversity and area of habitats to conserve bird species.
Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora)	The Habitats Directive targets the restoration of natural habitats and species of wild fauna and flora of Community interest at a favourable conservation status.



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EXAMPLES IN LOCAL POLICIES:

BLUE-GREEN NETWORK ŁÓDŹ, POLAND

The Blue-Green Network project in the city of Łódź in Poland is embedded in city landscape plan, creating a system that benefits all of its residents.

Because of rapid industrial development in the nineteenth century, most of the rivers have been channelized and integrated into the sewage system, destroying biodiversity. In 2006, a stakeholder platform, so-called “learning alliance” (LA) was established with the aim to share knowledge and discuss (often contradictory) objectives for water management.

Work carried out by the group resulted in the preparation of a short-term action plan that included fostering collaboration between scientific and administrative units, developing demonstration projects that promote ecohydrological solutions, and actions aimed at the successful implementation of these solutions.

Methods proposed by the LA were first tested in one of the demonstration sites, river Sokółówka. Measures included construction of dry reservoirs to increase stormwater retention and infiltration and sedimentation of pollutants, retention reservoirs with increased resistance to eutrophication (including toxic cyanobacterial blooms) and sedimentation polder where rainwater is purified and can later be retained in open reservoirs. Moreover, a rehabilitation plan for the river valley and the project of an urban park in the Sokółówka river valley were also developed.

The Blue-Green Network concept was officially adopted by the City of Łódź in 2012 as one of the components of the **Integrated Development Strategy** for Łódź 2020+.

Benefits of Blue-Green Infrastructure were: enhanced stormwater retention and purification, the prevention of flooding and drought; improved microclimate, air quality and decreased risk of allergy and asthma; improved resistance and reduced maintenance costs of urban greenery; space for recreation and green public transport; increased flexibility of the city in adapting to global climate change; and improved attractiveness of urban space to residents and investors.

WARELA INTERREG PROJECT, GERMANY, FRANCE, LUXEMBOURG, SWITZERLAND

Interreg project WaReLa aimed at creating the basis for co-operative international river basin management to ensure the permanent precaution of flood damage and promote high-quality and ecological international river basin management. The project brought together diverse experts, local water authorities, farmers, decision makers, specialists for floods and hydroclimatologists.

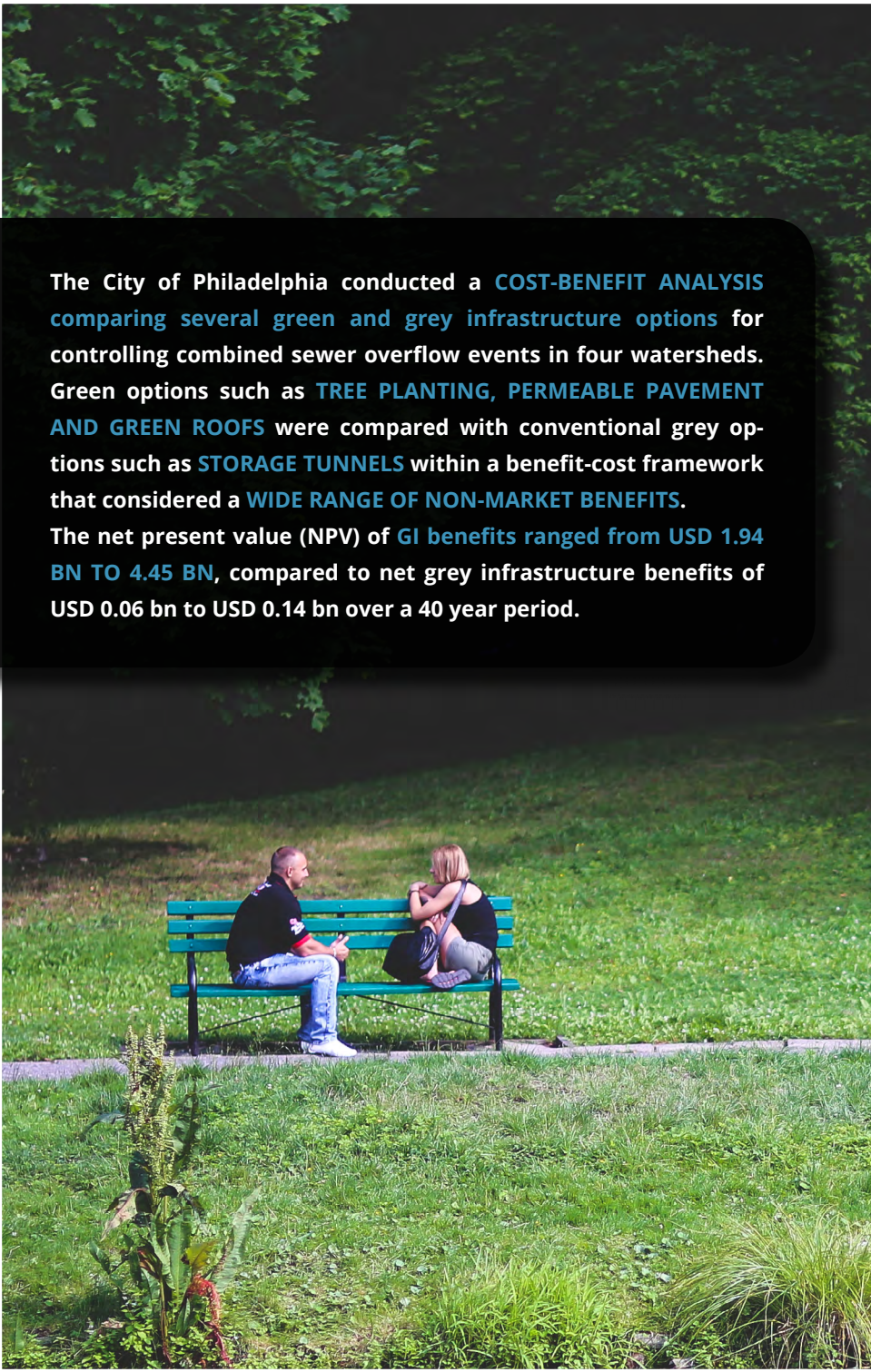
WaReLa used a GIS system to examine various factors linked to the incidence of flooding e.g. land use, landscape and geological structures. It created a comprehensive overview which was then integrated into regional planning frameworks and supported river basin management on international level. The project explored effective land use measures in forestry and agricultural sectors such as afforestation and building small retention reservoir for water retention, and implemented them at the test sites. Those sites are mapped as “hot spots” for run-off mitigation and delaying measures. All measures were evaluated with respect to their economic, ecological and water management efficiency.

Methods tested and results achieved by the project are integrated in spatial plans of the tested regions.

SUSTAINABLE INTEGRATED MANAGEMENT OF INTERNATIONAL RIVER CORRIDORS IN SEE COUNTRIES PROJECT

The SEE River project intended to synchronize development and conservation objectives in the process of planning integrated river corridor management for six pilot rivers on international level. It gathered experts from various fields, countries, interest groups and authorities on local, regional and national level. The main aim was to reach an agreement among these groups on an action plan and future implementation of local projects in the next financing period 2014 – 2020. The countries involved in the project were: Albania, Austria, Bosnia and Hercegovina, Croatia, Hungary, Italy, Romania, Serbia, Slovakia, Slovenia. Pilot rivers were: Bodrog, Neretva, Prut, Soča, Ujosa and Drava.

The generally applicable model and guidance how to reach common agreement on river management for the harmonization of both – development and conservation interests applied in the International Drava River Corridor (Drava River Action Plan) is described in a toolkit. This project also introduces a new approach to river and land use planning management by focusing on the wider river corridor rather than just the river itself.



The City of Philadelphia conducted a **COST-BENEFIT ANALYSIS** comparing several green and grey infrastructure options for controlling combined sewer overflow events in four watersheds. Green options such as **TREE PLANTING, PERMEABLE PAVEMENT AND GREEN ROOFS** were compared with conventional grey options such as **STORAGE TUNNELS** within a benefit-cost framework that considered a **WIDE RANGE OF NON-MARKET BENEFITS**. The net present value (NPV) of **GI benefits ranged from USD 1.94 BN TO 4.45 BN**, compared to net grey infrastructure benefits of **USD 0.06 bn to USD 0.14 bn** over a 40 year period.

WHAT IS STOPPING US FROM HAVING MORE BLUE AND GREEN INFRASTRUCTURE?

- **Lack of awareness** about the G-BI solutions and their benefits for biodiversity, society and economy;
- **Lack of adequate institutional and legal frameworks** for the deployment of green and blue infrastructure in the function of health and safety, especially outside of urban environments and protected areas;
- **Insufficient financial support** and/or incentives from EU and national governments for projects that involve green and blue infrastructure elements;
- **Different time frames** - blue infrastructure solutions for water management might take several years to fully deliver all their benefits. In contrast, grey infrastructure solutions offer immediate and highly visible results.

WHAT CAN YOU DO?

- Give priority to G-BI solutions when solving a current problem, become aware of their benefits;
- Compile comprehensive policies that incorporate nature into water management sector, such as Natura 2000 directives and biodiversity strategy;
- Promote strategies, plans and investments that take into account water scarcity challenges, natural solutions, and their wider benefits, in order to meet the needs of citizens;
- Become informed about funding possibilities for the integration of green-blue infrastructure into the water sector, provide this information to relevant authorities, businesses and organizations, and support them in project development;
- Identify, support, and promote organizations, authorities, and publications that promote G-BI solutions.



EXAMPLES OF GREEN-BLUE INFRASTRUCTURE PROJECTS

EXMOOR MIRES PEATLAND RESTORATION, UK

Under the Exmoor Mires project, 2000 ha of peatlands were restored by blocking historic drainage ditches. The project was initiated by the local water company South West Water (SWW) to use land management to tackle problems of water quality and quantity across South West England. The grey infrastructure alternative was to build a second reservoir which would cost 90 million GBP, while the restoration costs were estimated at only 5-10 million GBP.

The primary benefit for the company was to reduce the cost of water treatment. An estimate of the cost of restoration and operating water treatment works in SW England suggests that delaying the upgrade of major treatment works by 10 years would offer a benefit-cost ratio of 65:1 over 30 years.

Additionally, it reduced runoff by 32% and increased water storage (additional 364 m³/ha). It also ensured that the catchment provides the company with treatable water for the future, keeps rivers flowing in periods of drought, and protects the customers from flooding by slowing down the river flow. Other benefits of the project have been: climate regulation by carbon storage (if all this peat was to be removed from Exmoor by Oxidation erosion, peat cutting or other means this would release 3.7 million tons of CO₂ into the atmosphere) and habitat provision.

The project continues operating in cooperation between the company, the Exmoor National Park Authority and national agencies. The actions are funded through agri-environment payments for moorland management. In the future, a PES scheme with payments from water companies is planned to be developed.

FLOOD MEADOWS IN THE MARAIS POITEVIN, FRANCE

The Marais Poitevin is the 2nd largest wetland in France. The area of about 2000 ha of flood meadows is owned by local municipalities and commonly managed with local farmers. Cooperation started back in the 1980s when local public organizations, municipalities, environmental NGOs and farmers decided to counteract the destruction of the meadows. Actions taken reinforced traditional agriculture supporting natural, pluri-specific pastures: cattle, horses, geese. Benefits arising from the Marais Poitevin are now mainly connected to water regulation, water storage during floods, groundwater recharge, the removal of pollutants as well as preserving biodiversity and landscape. In addition the public organization Parc Interrégional du Marais Poitevin (PIMP) performs activities also benefiting the economy and land planning (tourism, architecture, urbanism), culture and heritage, and education.

The project is funded by environmental associations (LPO and WWF) with 15 EUR/year for each hectare of common floodmeadow (450,000 EUR for the 15 years of the agreement) supporting involved municipalities. Farmers and municipalities have been receiving agri-environmental payments since 1993 (or 1997 for some of the flood meadows).

LIMNOTOP: ECO-REMEDIATION NEAR ORMOZ, SLOVENIA

Landfills' emissions of leachate and biogas present major environmental threats of such waste disposal. Common grey infrastructure solutions reducing the emissions are physical barriers (mineral, synthetic liners), which prevent the formation of landfill leachate and gases. However, because of its durability, it is not a sustainable solution. Municipality of Ormoz in Slovenia decided to choose a green alternative for the landfill site of Dobrava. Measures taken included establishing dense woodland as a water barrier and constructing a wetland for leachate treatment to prevent water contamination. Under this work 4 ha of the landfill were reconstructed with the leachate recirculation to the landfill vegetative cover and soil layers permitting infiltration of water into the landfill body. The pre-treatment of the leachate took place in a constructed wetland of 1,000 m², from where water was pumped through an underground irrigation system to the covered part of the landfill.

The cost of the project was 594,721 EUR, however, savings in comparison to leachate treatment systems are 51%. Moreover, choosing green-blue infrastructure solutions allowed secondary use of reconstructed landfill. This option is more accepted by the locals, landfill stabilization is faster and trees contribute to leachate treatment. Due to the closed hydrological and pollution cycle, the negative impact on the environment is reduced and the landfill site is lastingly rehabilitated.

CURRENT EU FUNDING POSSIBILITIES FOR INTEGRATING GREEN AND BLUE INFRASTRUCTURE

EUROPEAN REGIONAL DEVELOPMENT FUND (ERDF):

Thematic objective 5 - promoting climate change adaptation, risk prevention and management - it is possible to have dedicated investments for adaptation to climate change which can include developing green and blue infrastructure to ensure local/regional adaptation to climate change. The same objective is present in the Cohesion Fund (CF) as well.

Thematic objective 6 – protecting the environment and promoting resource efficiency – it is possible to develop, implement and monitor elements of G-BI in urban and peri-urban areas through the actions that aim to improve the urban environment.

Under **thematic objective 10** - by investing in education, skills and lifelong learning by developing education and training infrastructure, it can be possible to educate health professionals on the benefits and the importance of green and blue infrastructure.

OTHER FUNDS:

Rural Development Programme that is funding under agri-environmental climate measures, non-productive investment measures;

LIFE programme 2014-2020 that gives priority to integrated water catchment projects, especially in Natura 2000 areas, while still supporting smaller scale projects focusing on nature conservation;

The EU research programme Horizon 2020 offers funding opportunities for research on G-BI under the Climate Action, Environment section;

Private funding can be used through biodiversity compensation, Payment for Ecosystem Services schemes, carbon certificates or entry fees.



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WHERE CAN I FIND FURTHER INFORMATION?

CEEWEB FOR BIODIVERSITY has vast experience in all aspects of green infrastructure, including policy and project development, providing training for stakeholders and implementing projects at local, national and international level. This experience is further maximized and enhanced through our network of non-governmental organizations in Central and Eastern Europe. We have collected extended knowledge on green-blue infrastructure and its beneficial role in providing human health and wellbeing.

You can consult our Green Infrastructure Hub with a large number of articles and videos at:

www.ceeweb.org/green-infrastructure/

or you can contact our *Natura 2000 and Water Policy Officer*:

Monika Kotulak: kotulak@ceeweb.org.



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A BRIGHTER FUTURE - WITH A LITTLE HELP FROM OUR NATURE

GREEN-BLUE INFRASTRUCTURE INTEGRATION INTO A WATER SECTOR

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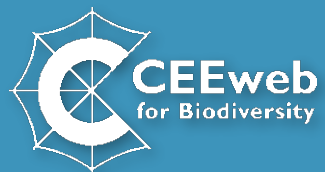
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