Riqualificazione fluviale

Non solo tubi: nuovi approcci per ridurre l'inquinamento delle acque in Italia

Infrastrutture verdi-blu per la qualità delle acque

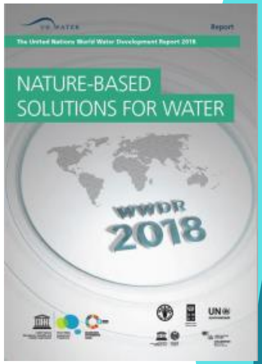
Anacleto Rizzo – Iridra s.r.l.

Infrastrutture verdi e blu ed NBS

“Solutions that are inspired and supported by nature, which are **cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience.** Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions.”

European Commission

“NBS use or mimic natural processes to **enhance water availability, improve water quality, and reduce risks associated with water-related disasters and climate change.”**



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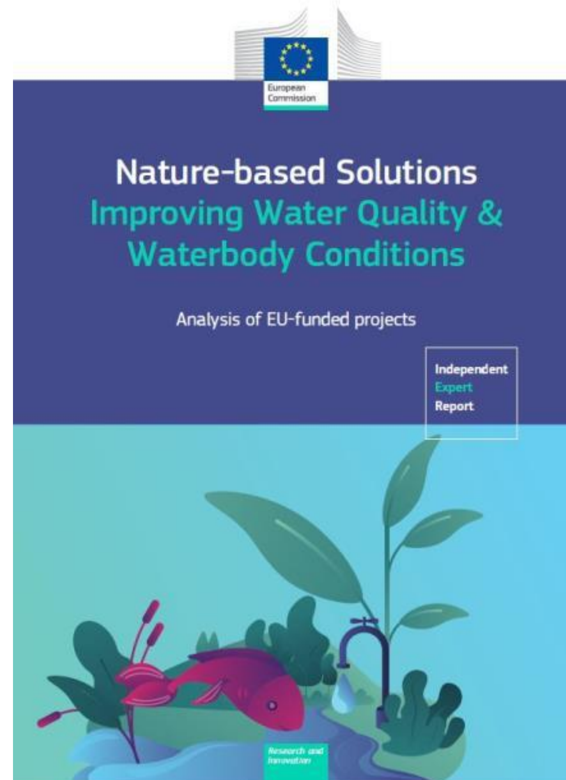
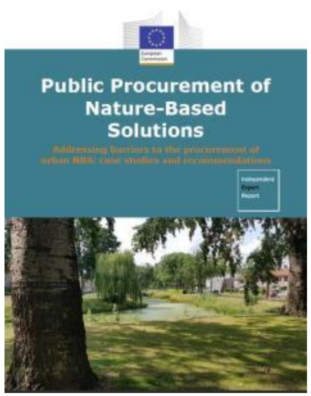
Dipartimento di Ingegneria Civile

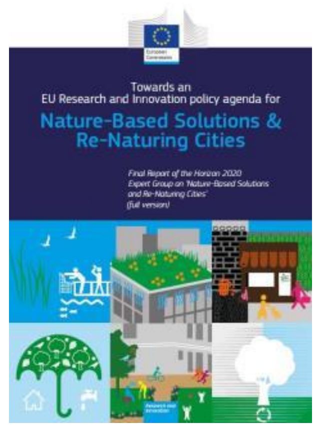
Riqualificazione fluviale

Interesse EU per le NBS

European Commission







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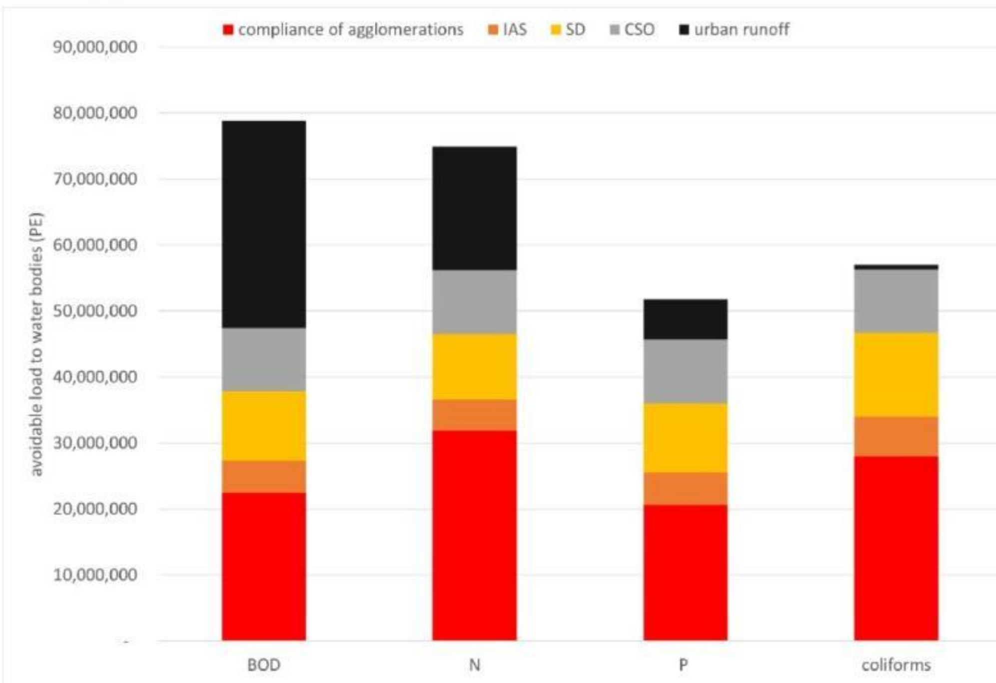
DICIV Dipartimento di Ingegneria Civile

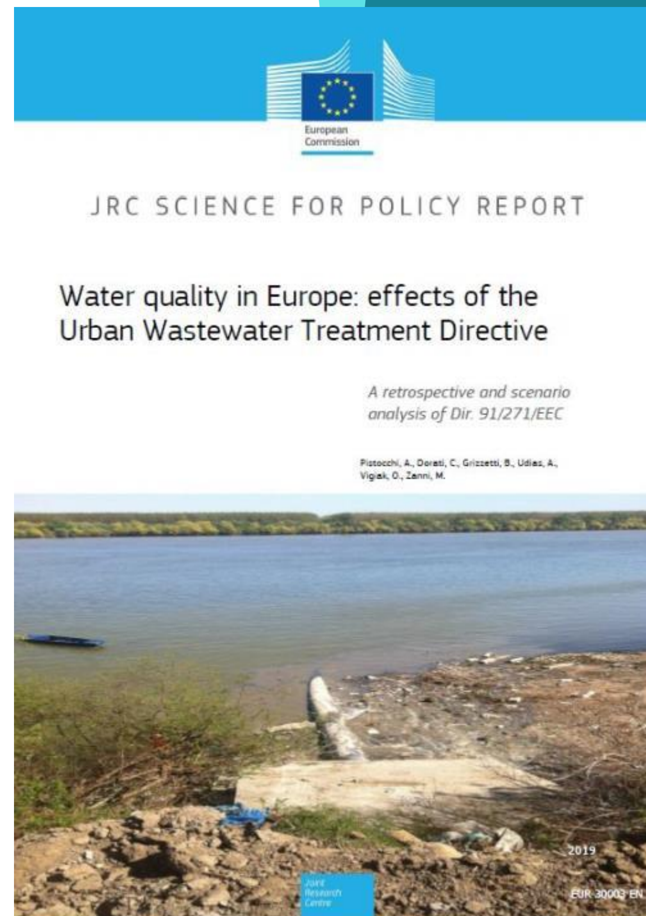
Riqualificazione fluviale

EU e WFD

European Commission

Figure 67 –loads that can be avoided by enforcing full compliance with the UWWTD (for agglomerations); an equivalent treatment level (for scattered dwellings, SD); full control of CSO (neglecting management measures currently in place); and effective enforcement of IAS treatment equivalent to the WWTP of the corresponding agglomeration.





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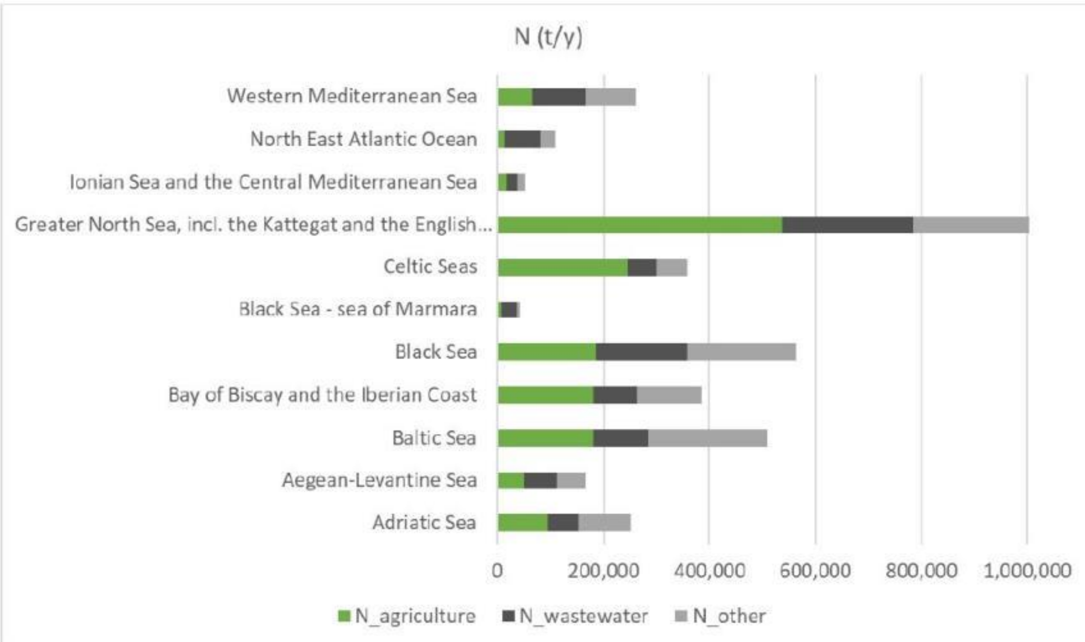
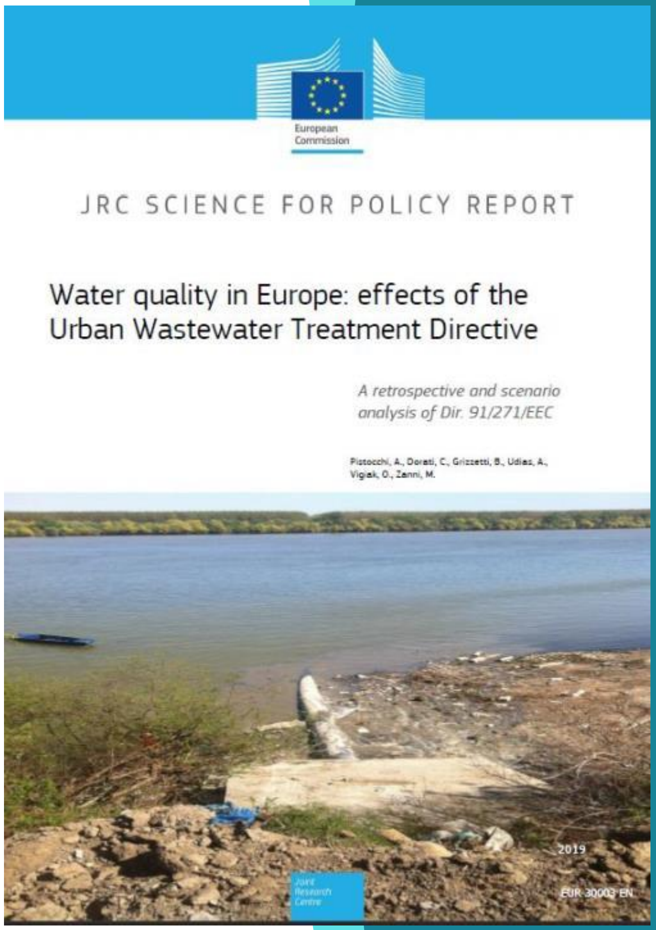
Riqualificazione fluviale

EU e WFD

European Commission

Figure 69 – loads of N and P to EU regional seas by source (tonnes per year): above, N; below, P





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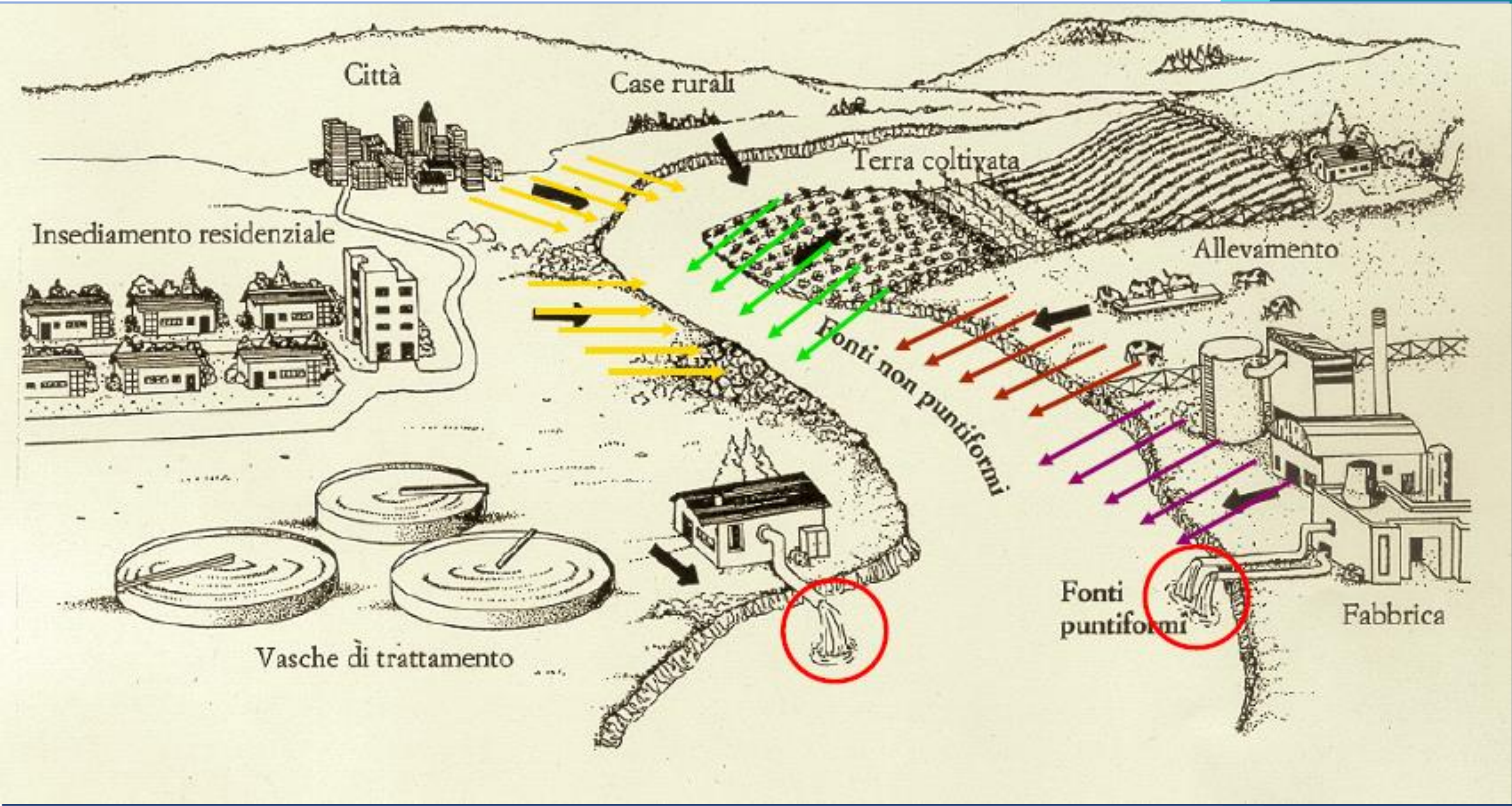
Riqualificazione fluviale


Città
Case rurali
Terra coltivata
Insediamento residenziale
Allevamento
Fonti non puntiformi
Fonti puntiformi
Fabbrica
Vasche di trattamento

NBS per inquinamento puntuale

NBS per scarichi puntuali
Fitodepurazione: diffusione EU

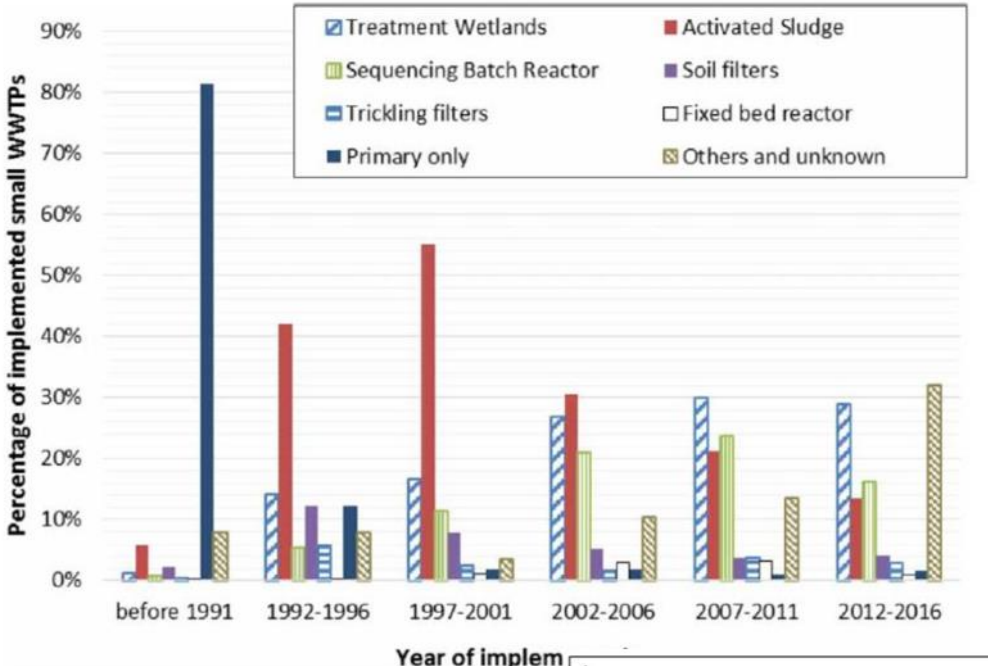


Figure 3 | Percentage of implemented small WWTPs in Austria.

< 500 AE

1 © IWA Publishing 2017 Water Science & Technology | in press | 2017

Survey on number and size distribution of treatment wetlands in Austria

Guenter Langergraber and Norbert Weissenbacher

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Dipartimento di Ingegneria Civile

Riqualificazione fluviale

NBS per scarichi puntuali
Fitodepurazione: classica

Flusso superficiale
(**FWS**)

Flusso sommerso
orizzontale
(**HF**)

Flusso sommerso
verticale
(**VF**)

CIRF
Centro Italiano per la
Riqualificazione Fluviale

NBS per scarichi puntuali

Fitodepurazione: innovazione

Fitodepurazione aerata
(**FBA™**)

Riduzione aree d'ingombro fino a 4-5 volte rispetto alle soluzioni classiche

Fitodepurazione senza fosse settiche "alla Francese"
(**FRB**)

Assenza di trattamenti primari (vasche settiche), nessuna produzione di fanghi

NBS per scarichi puntuali

Tratt. secondario: Castelluccio di Norcia (1000 AE)

- 1.000 AE
- 1° impianto di fitodepurazione senza fosse settiche per reflui civili in Italia
- Inserito in area ad alto valore naturalistico (Parco Naturale dei Monti Sibillini)

CASTELLUCCIO – FRB+VF	1000 a.e.
Portata di progetto (m^3/g)	200
Superficie utile (m^2)	2000
Costi di investimento (€)	400.000
Costi di gestione (€/y)	5.000
Operativo dal	2013

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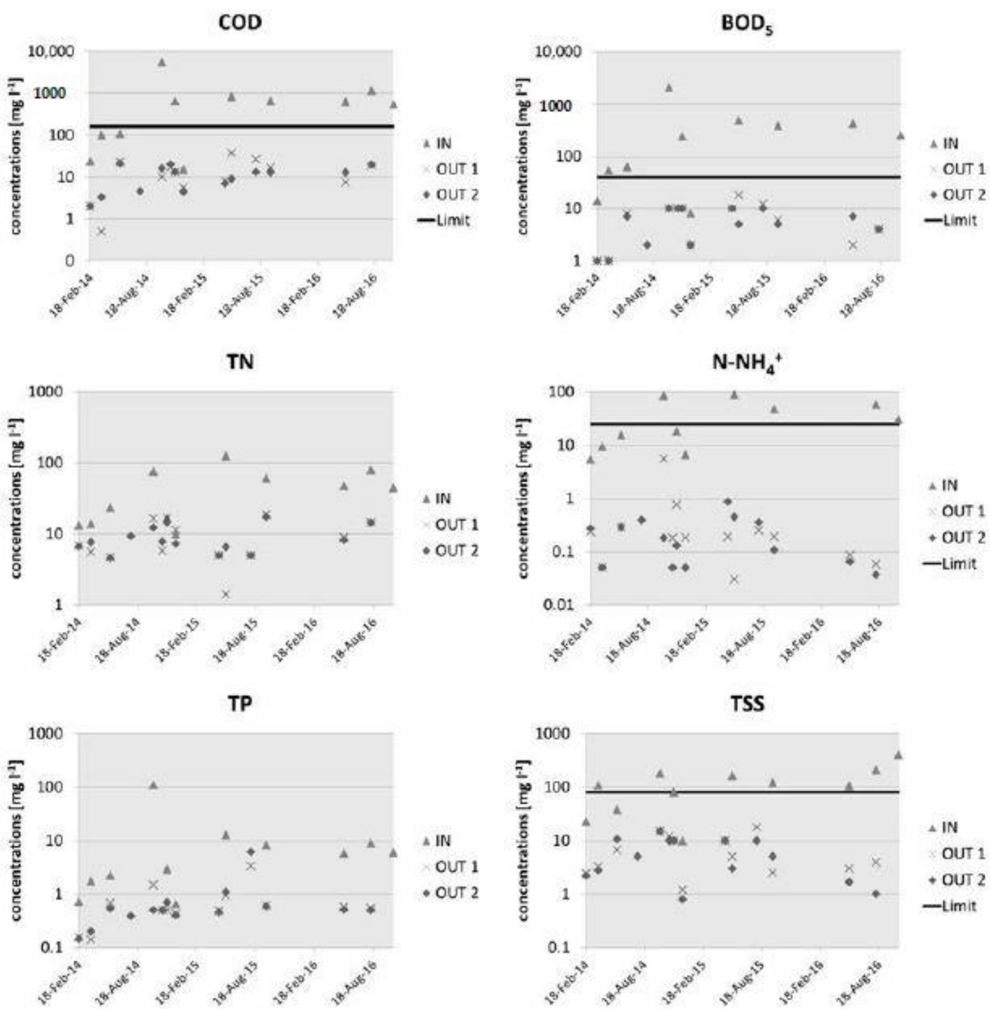
NBS per scarichi puntuali

Tratt. secondario: Castelluccio di Norcia (1000 AE)




water
MDPI
Article
French Reed Bed as a Solution to Minimize the Operational and Maintenance Costs of Wastewater Treatment from a Small Settlement: An Italian Example

Anacleto Rizzo, Riccardo Bresciani, Nicola Martinuzzi and Fabio Masi *
IRIDRA Srl, via La Marmora 51, 50121 Florence, Italy; rizzo@iridra.com (A.R.); bresciani@iridra.com (R.B.); martinuzzi@iridra.com (N.M.)
* Correspondence: fmasi@iridra.com

Received: 29 December 2017; Accepted: 2 February 2018; Published: 6 February 2018

ne fluviale

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NBS per scarichi puntuali

Tratt. secondario: Castelluccio di Norcia (1000 AE)

	FRB WWTP of Castelluccio di Norcia		Activated Sludge Systems *			
			500 PE		1000 PE	
	500 PE	1000 PE	min	max	min	max
Construction costs (€ PE^{-1})		364 **–394 ***			263	360
O&M average yearly costs (€ PE^{-1} $year^{-1}$)	11	6 ****	54	90	45	75

Notes: * Data from Italian context with scheme: activated sludge with classical scheme + tertiary filtration + UV disinfection [23]; ** Without FWS: FRB + VF; *** With FWS: FRB + VF + FWS; **** Assuming the same O&M costs except the energy costs for consumed kWh, which are doubled.

water

MDPI

Article

French Reed Bed as a Solution to Minimize the Operational and Maintenance Costs of Wastewater Treatment from a Small Settlement: An Italian Example

Anacleto Rizzo, Riccardo Bresciani, Nicola Martinuzzi and Fabio Masi *

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ne fluviale

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NBS per scarichi puntuali

Tratt. secondario: Ohrei (Moldavia – 20000 AE)

- 20.000 AE
- tra i più grandi impianti di fitodepurazione secondari in Europa e nel mondo

NBS per scarichi puntuali

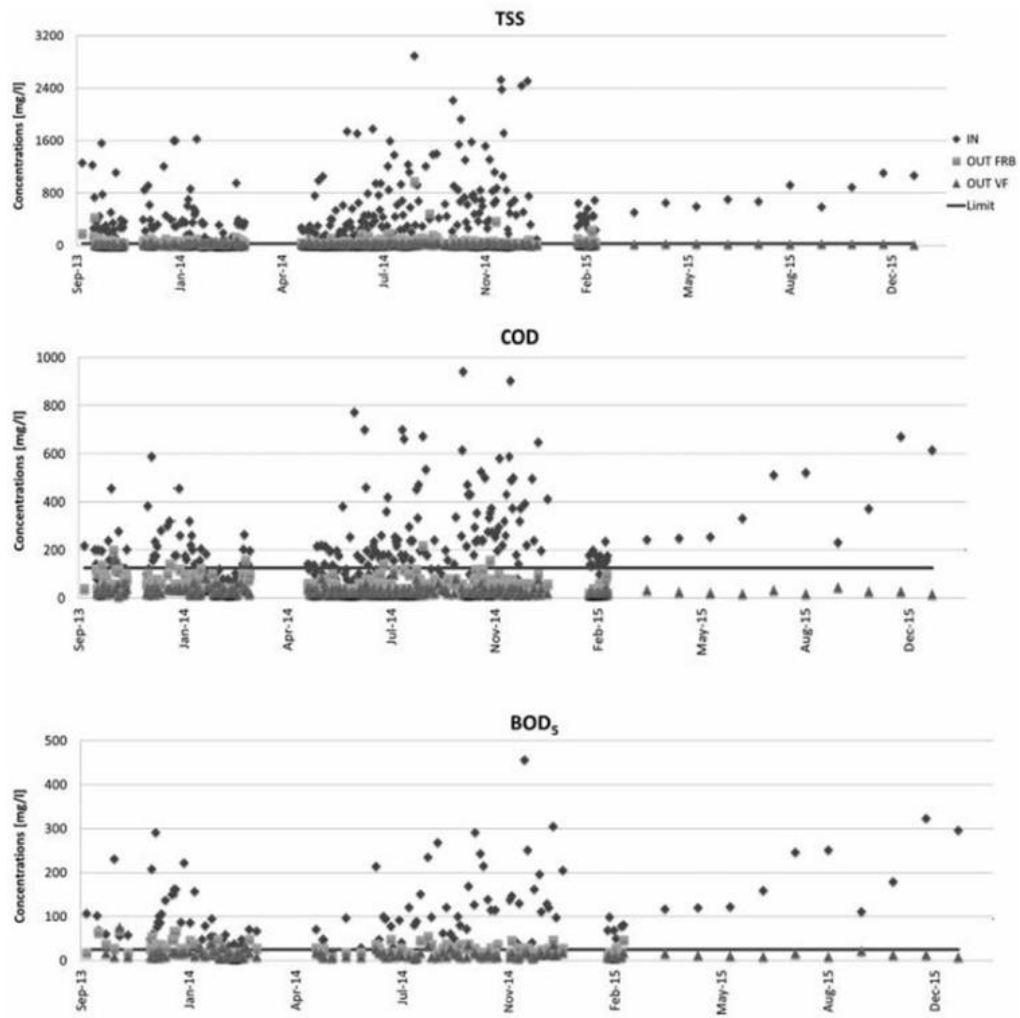
Tratt. secondario: Ohrei (Moldavia – 20000 AE)

1 © IWA Publishing 2017 Water Science & Technology | in press | 2017

Large scale application of French reed beds: municipal wastewater treatment for a 20,000 inhabitant's town in Moldova

F. Masi, R. Bresciani, N. Martinuzzi, G. Cigarini and A. Rizzo

- COD<125 mg/l
- BOD5< 25 mg/l
- TSS<35 mg/l
- **T min: -27 °C**



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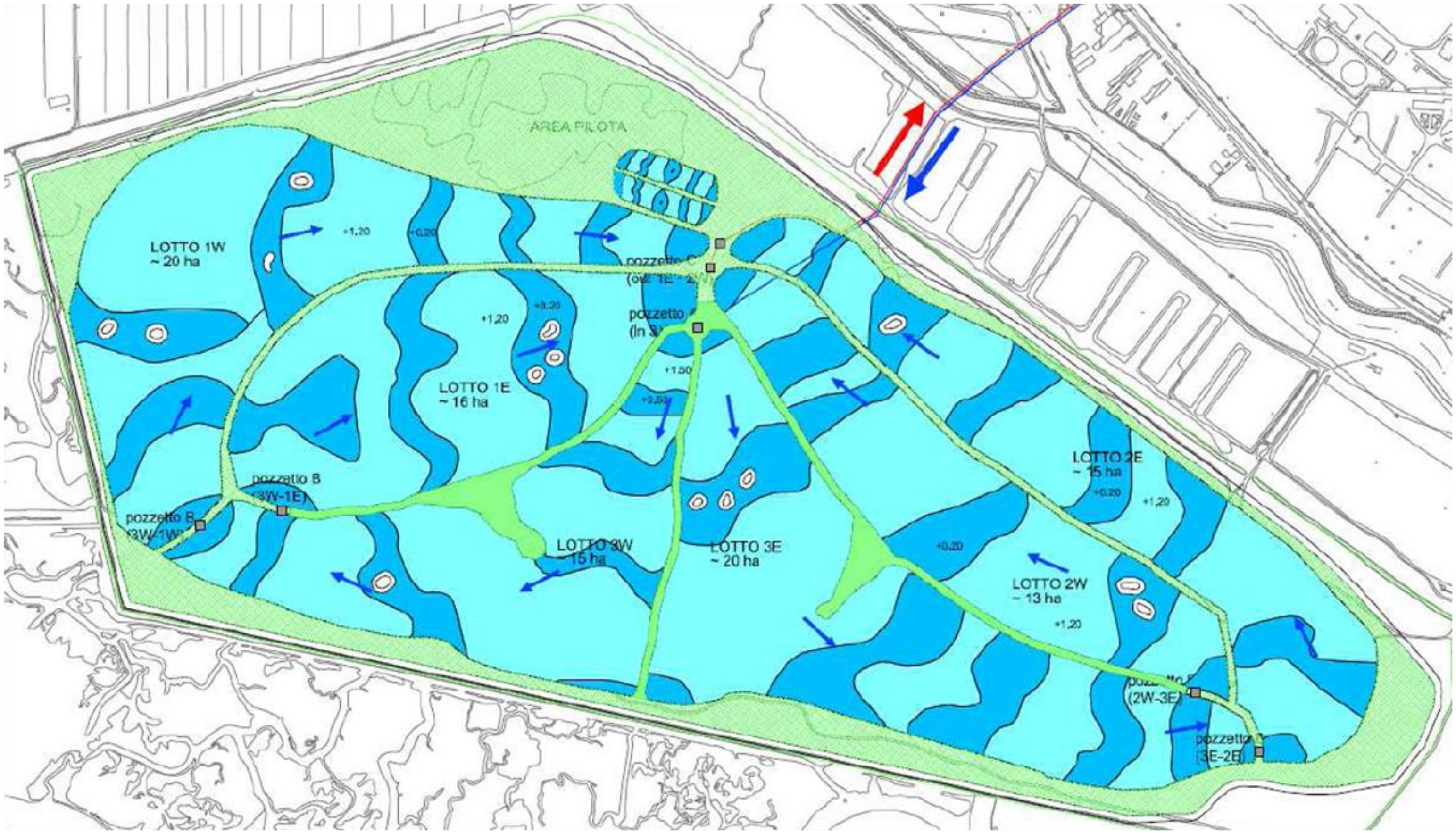
NBS per scarichi puntuali
Tratt. terziario: Jesi (60000 AE)

Schema WWTP:

1. Fanghi attivi
2. Fitodepurazione terziaria
   - Primo stadio: HF 10000 mq
   - Secondo stadio: FWS 50000 mq
3. Riutilizzo acque reflue depurate

NBS per scarichi puntuali

Tratt. terziario: Fusina (ME - 480000 AE)

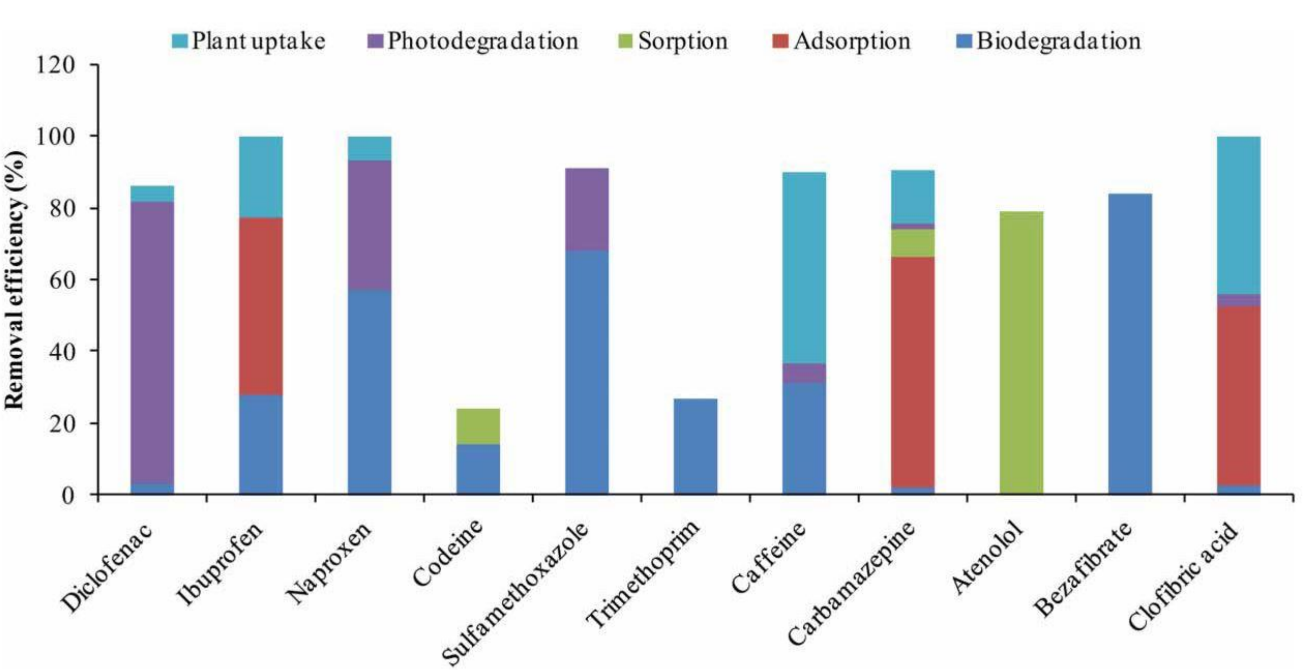


Superficie pari a 110 ha

NBS per scarichi puntuali
Tratt. terziario: Fusina (ME - 480000 AE)

NBS per scarichi puntuali

Rimozione inquinanti emergenti



253 © 2020 The Authors Journal of Water and Health | 18.3 | 2020

Pharmaceuticals' removal by constructed wetlands: a critical evaluation and meta-analysis on performance, risk reduction, and role of physicochemical properties on removal mechanisms

Huma Ilyas, Ilyas Masih IWA and Eric D. van Hullebusch IWA

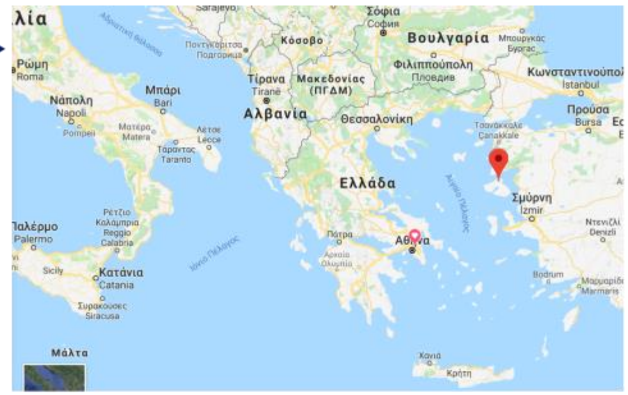
:ione fluviale

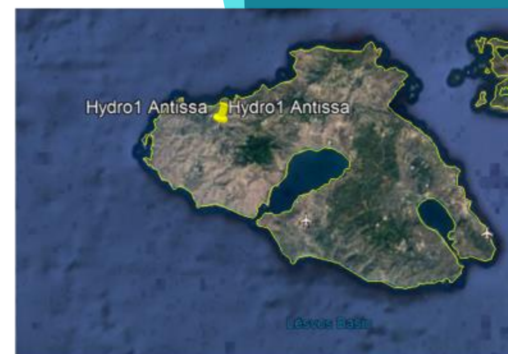
NBS per scarichi puntuali
Riuso

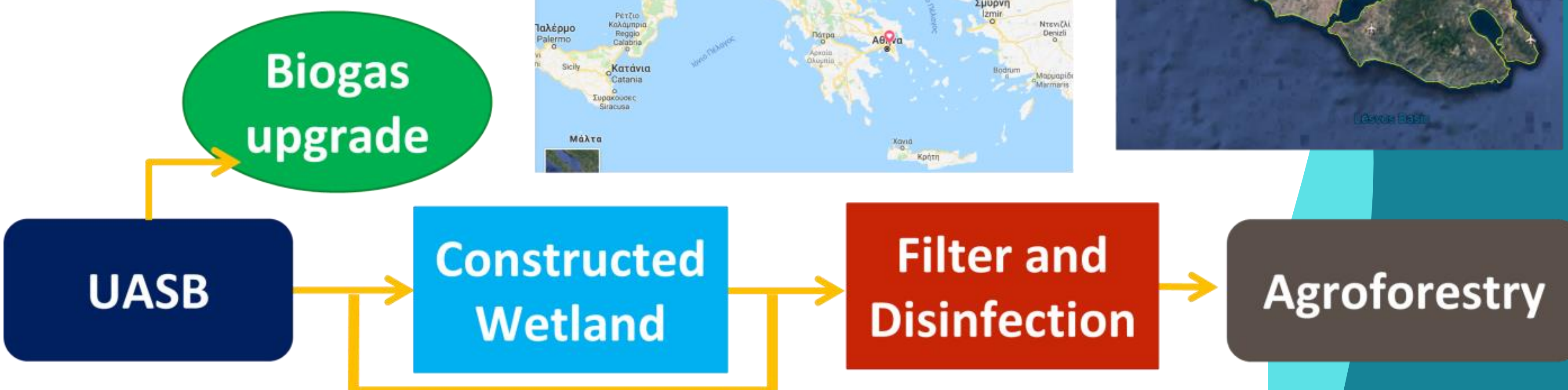
NBS per scarichi puntuali

Riuso

Location







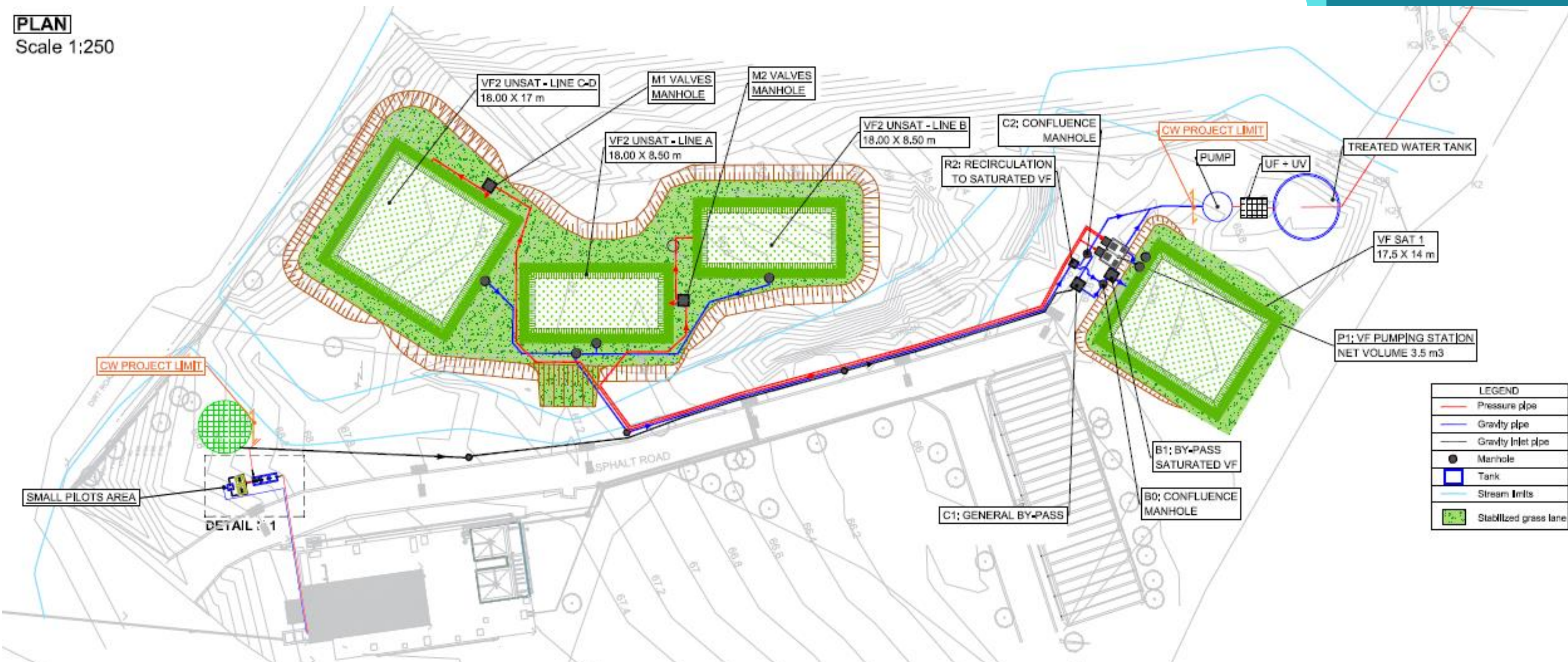
Riqualificazione fluviale

Centro Italiano per la Riqualificazione Fluviale

Dipartimento di Ingegneria Civile

NBS per scarichi puntuali

Riuso



Riqualificazione fluviale

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Dipartimento di Ingegneria Civile

NBS per scarichi puntuali

Riuso

Riqualificazione fluviale

NBS per scarichi puntuali

Riuso

Seabuckthorn

Pomegranate

Apple tree

Rosemary

Catnip

Mint

Quinoa

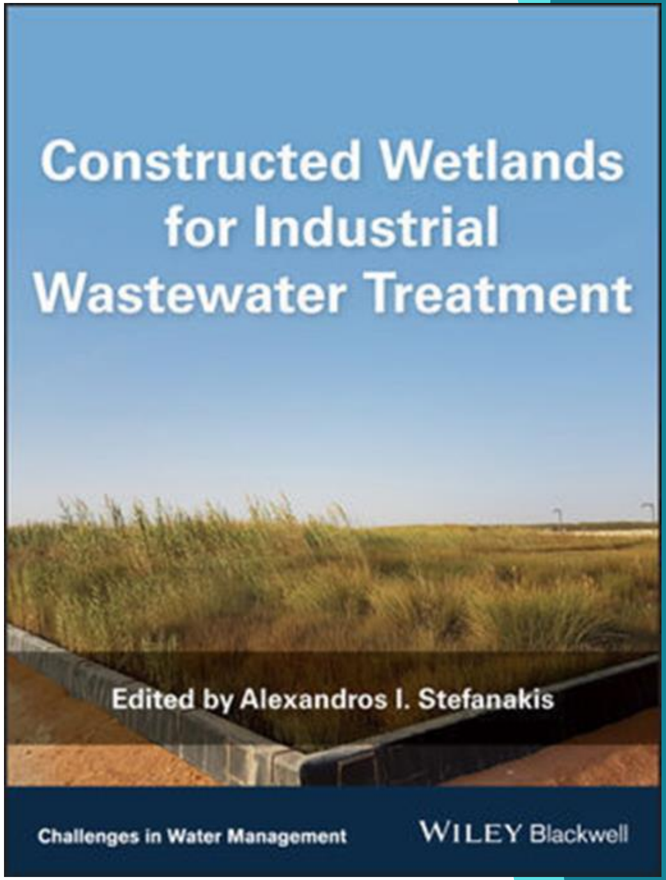
Camelina

Chestnut tree

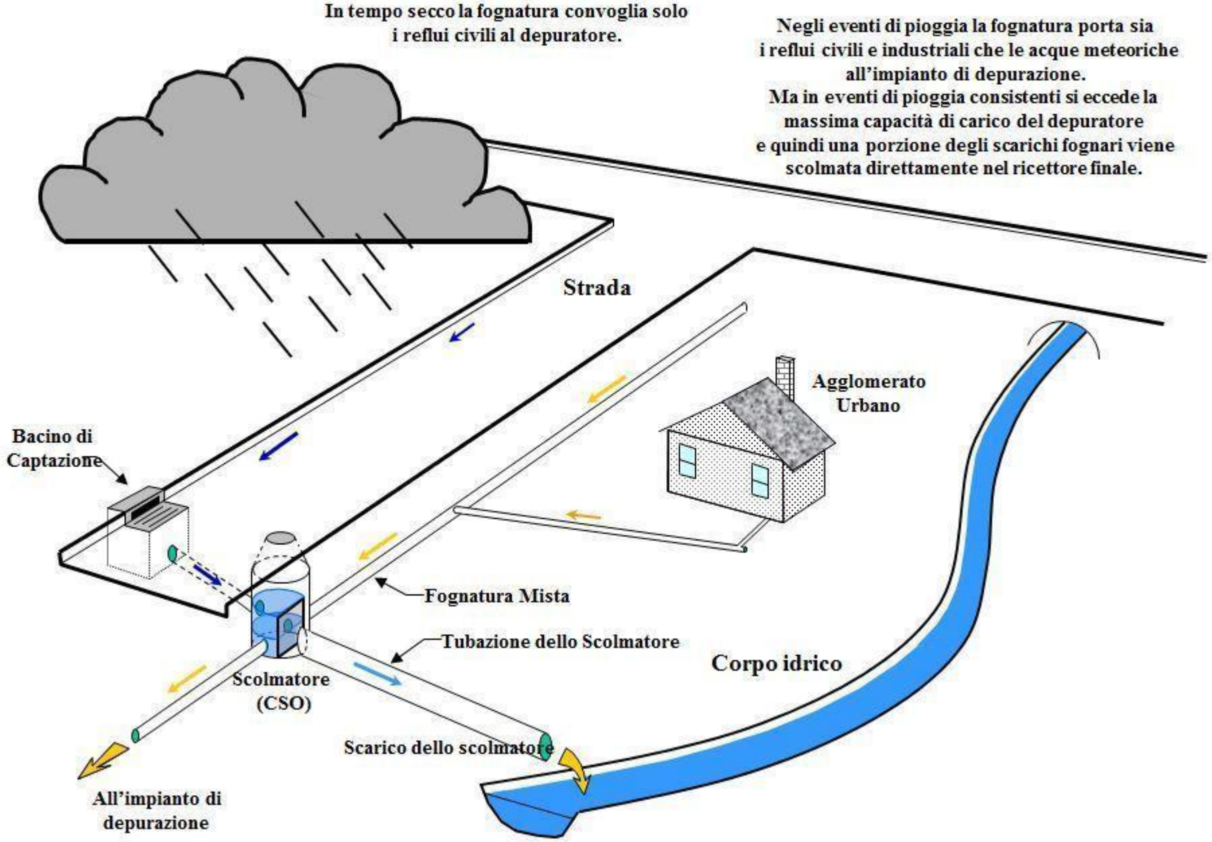
NBS per scarichi puntuali

Industriali

- 93 autori
- 22 paesi
- Più di 20 campi di applicazione in ambiente industriale



NBS per scarichi puntuali
CSO – Sfioratori da fognatura mista



NBS per scarichi puntuali

CSO – Sfioratori da fognatura mista

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Review

Constructed wetlands for combined sewer overflow treatment: A state-of-the-art review

A. Rizzo [a], K. Tondera [b,c,*], T.G. Pálfy [c,j], U. Dittmer [d], D. Meyer [e], C. Schreiber [f], N. Zacharias [f], J.P. Ruppelt [g], D. Esser [h], P. Molle [c], S. Troesch [i], F. Masi [a]

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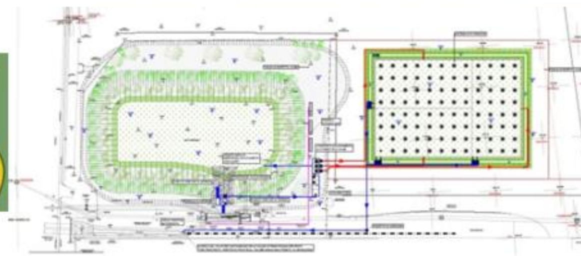
[h] SINT, Société d'Ingénierie Nature & Technique, Chef-Lieu, F-73370 La Chapelle du Mont du Chat, France
[i] Eco Bird, 3 route du Dôme, 69630 Chaponost, France
[j] University of Sopron, Institute of Geomatics and Civil Engineering, H-9400 Sopron, Hungary



ESPERIENZE IRIDRA CW-CSO

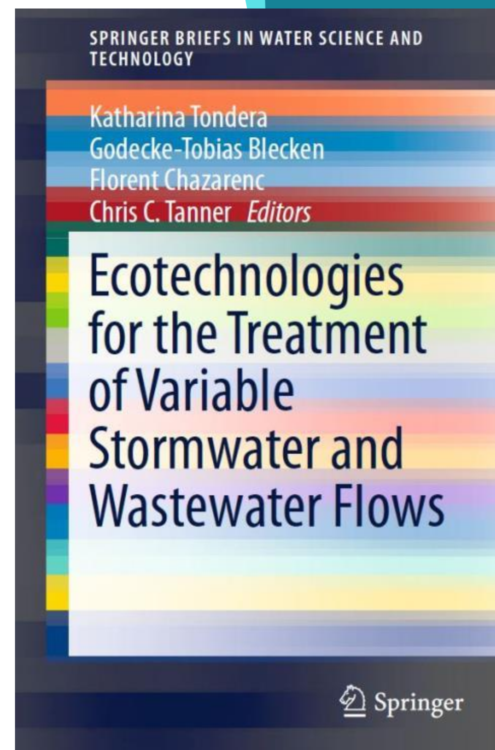
- *Parco dell'acqua Gorla Maggiore (2012) – Premio per lo sviluppo sostenibile 2017*
- *Fitodepurazione sfioro di testa depuratore di Carimate (2018)*
- *Fitodepurazione Villaguardia via Torino (2018)*
- *Fitodepurazione Mesero (Progetto esecutivo - 2019)*
- *Fitodepurazione Villaguardia via Firenze (progetto definitivo - 2020)*

NBS per scarichi puntuali

Acque di prima pioggia fognatura separata

Villese-Gorizie highway, Veneto Region (Italy)

- Multipurpose nature-based solution: environmental impact mitigation, landscaping improvement of highway. Designed by AI staff for Autovie Venete



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Riqualificazione fluviale

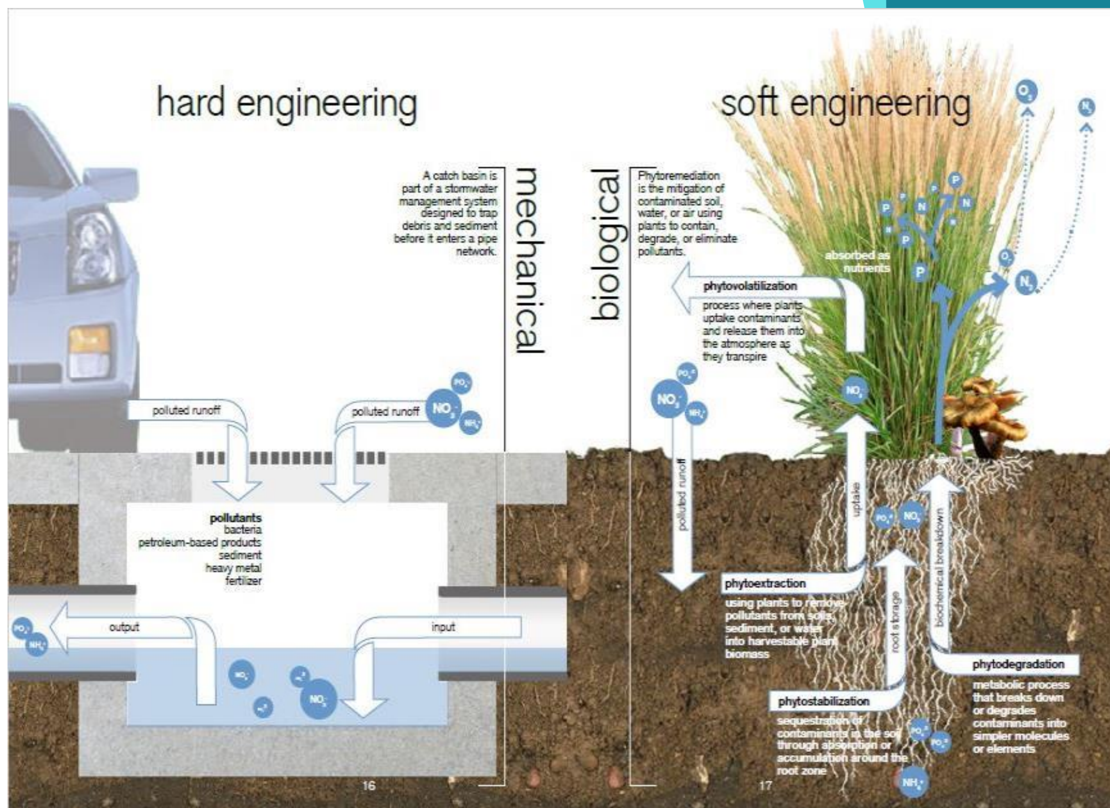
IRIDRA S.r.l.

NBS per inquinamento diffuso

NBS per inquinamento diffuso

Urbano: Drenaggio urbano sostenibile (SuDS)

1. regolazione atmosferica
2. regolazione climatica
3. regolazione idrica
4. recupero delle acque
5. controllo dell'erosione e trattenimento dei sedimenti
6. formazione di suolo
7. bilanciamento cicli dei nutrienti
8. riduzione carico inquinante sfruttando i processi naturali
9. pollinazione
10. aumento biodiversità
11. produzione di biomasse
12. aumento aree ricreative
13. educazione ambientale



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Riqualificazione fluviale

NBS per inquinamento diffuso

Urbano: Drenaggio urbano sostenibile (SuDS)

Centro ricerche Kerakoll, Sassuolo (MO)

- Area di bioritenzione (rain garden)

NBS per inquinamento diffuso

Urbano: Drenaggio urbano sostenibile (SuDS)

Proposte progettuali per Viale Tanini di Firenze nell'ambito dell'assistenza tecnica della BEI "*Florence Climate Change Adaptation*"

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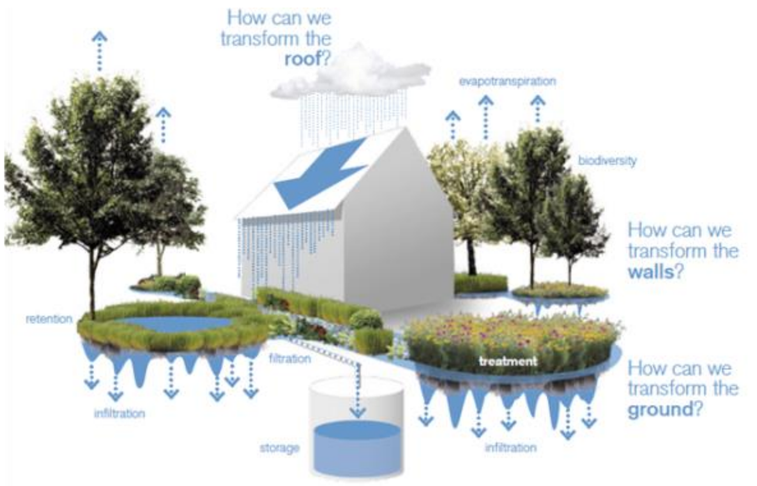
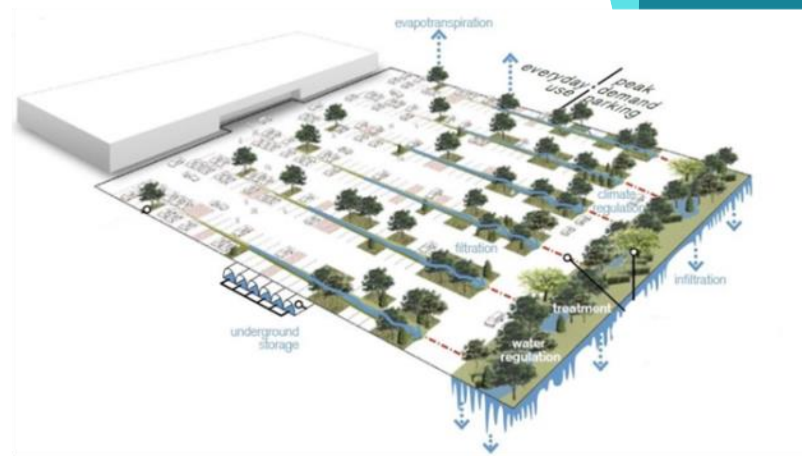
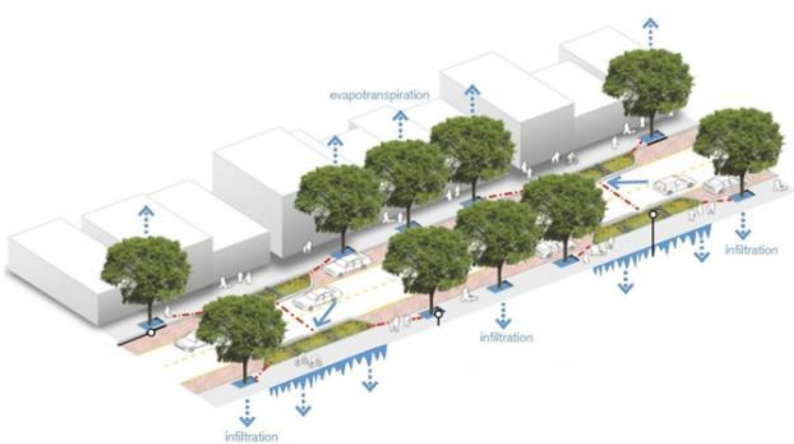
NBS per inquinamento diffuso

Urbano: Drenaggio urbano sostenibile (SuDS)





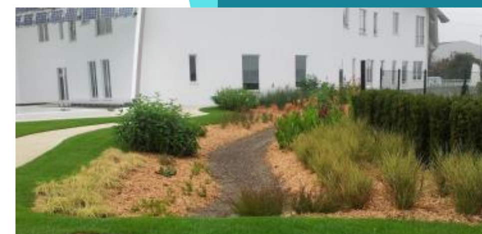


NBS per inquinamento diffuso

Urbano: Drenaggio urbano sostenibile (SuDS)

TABLE 7.1 SuDS component delivery of design criteria

Component type	Description	Collection mechanism	Design criteria: Water quantity (Chapter 3): Peak runoff rate	Water quantity: Runoff volumes: Small events (Interceptions)	Water quantity: Runoff volumes: Large events	Water quality (Chapter 4)	Amenity (Chapter 5)	Biodiversity (Chapter 6)
Rainwater harvesting systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		●	●		●	
Green roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	●		●	●	●
Infiltration systems	Systems that collect and store runoff, allowing it to infiltrate into the ground	P	●	●	●	●	●	●
Proprietary treatment systems	Subsurface structures designed to provide treatment of runoff	P				●		
Filter strips	Grass strips that promote sedimentation and filtration as runoff is conveyed over the surface	L		●		●	○	○
Filter drains	Shallow stone-filled trenches that provide attenuation, conveyance and treatment of runoff	L	●	○		●	○	○
Swales	Vegetated channels (sometimes planted) used to convey and treat runoff	L	●	●	●	●	●	●
Bioretention systems	Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils	P	●	●	●	●	●	●
Trees	Trees within soil-filled tree pits, tree planters or structural soils used to collect, store and treat runoff	P	●	●		●	●	●
Pervious pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	S	●	●	●	●	○	○
Attenuation storage tanks	Large, below-ground voided spaces used to temporarily store runoff before infiltration, controlled release or use	P	●					
Detention basins	Vegetated depressions that store and treat runoff	P	●	●		●	●	●
Ponds and wetlands	Permanent pools of water used to facilitate treatment of runoff – runoff can also be stored in an attenuation zone above the pool	P	●			●	●	●



qualificazione fluviale

NBS per inquinamento diffuso

Urbano: Drenaggio urbano sostenibile (SuDS)

TABLE 7.1 SuDS component delivery of design criteria

Component type	Description	Collection mechanism	Design criteria: Water quantity (Chapter 3): Peak runoff rate	Water quantity: Runoff volumes: Small events (Interceptions)	Water quantity: Runoff volumes: Large events	Water quality (Chapter 4)	Amenity (Chapter 5)	Biodiversity (Chapter 6)
Rainwater harvesting systems	Systems that collect runoff from the roof of a building or other paved surface for use	P		•	•		•	
Green roofs	Planted soil layers on the roof of buildings that slow and store runoff	S	○	•		•	•	•
Infiltration systems	Systems that collect and store runoff, allowing it to infiltrate into the ground	P	•	•	•	•	•	•
Proprietary treatment systems	Subsurface structures designed to provide treatment of runoff	P				•		
Filter strips	Grass strips that promote sedimentation and filtration as runoff is conveyed over the surface	L		•		•	○	○
Filter drains	Shallow stone-filled trenches that provide attenuation, conveyance and treatment of runoff	L	•	○		•	○	○
Swales	Vegetated channels (sometimes planted) used to convey and treat runoff	L	•	•	•	•	•	•
Bioretention systems	Shallow landscaped depressions that allow runoff to pond temporarily on the surface, before filtering through vegetation and underlying soils	P	•	•	•	•	•	•
Trees	Trees within soil-filled tree pits, tree planters or structural soils used to collect, store and treat runoff	P	•	•		•	•	•
Pervious pavements	Structural paving through which runoff can soak and subsequently be stored in the sub-base beneath, and/or allowed to infiltrate into the ground below	S	•	•	•	•	○	○
Attenuation storage tanks	Large, below-ground voided spaces used to temporarily store runoff before infiltration, controlled release or use	P	•					
Detention basins	Vegetated depressions that store and treat runoff	P	•	•		•	•	•
Ponds and wetlands	Permanent pools of water used to facilitate treatment of runoff – runoff can also be stored in an attenuation zone above the pool	P	•			•	•	•

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

Type of SuDS component	Mitigation indices[1]: TSS	Metals	Hydrocarbons
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

TABLE 18.1 Pollution removal for bioretention systems designed to FAWB guidelines (after FAWB, 2009)

Pollutant	Typical removal efficiency
TSS	> 90%
Total phosphorous	> 80%
Nitrogen	50% on average
Metals (zinc, lead, cadmium)	> 90%
Metals (copper)	up to 60%

qualificazione fluviale

NBS per inquinamento diffuso

Agricolo

- Fossi vegetati di drenaggio

  (VDD – Vegetated drainage ditches)

- Fasce Tampone
- Fitodepurazione

NBS per inquinamento diffuso

Agricolo: Vegetated drainage ditches

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Review

Removal of non-point source pollutants from domestic sewage and agricultural runoff by vegetated drainage ditches (VDDs): Design, mechanism, management strategies, and future directions

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NBS per inquinamento diffuso

Agricolo: Fasce tampone

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Table 1. Summary table illustrating typical water (and air) quality functions of riparian zones with respect to a variety of environmental contaminants, along with a description of key riparian characteristics associated with each contaminant's removal and degradation or production. References to source papers can be found in the text.

Riparian zone (RZ) function with respect to select compounds	RZ impact on select compounds and optimal conditions for removal and degradation or production
RZs and NO_3^-	RZs act as N sinks, NO_3^- removal efficiency is often >90%, except in gravel- or sand-dominated riparian zones. Optimal conditions: high NO_3^- and high organic matter, anaerobic conditions and high water table, 20–30°C (warm temperature).
RZs and total P, sediment, and pesticides in overland flow	RZ trapping efficiency is extremely variable, but >50% in most cases. Optimal conditions: herbaceous vegetation, high soil water infiltration capacity, low water table to reduce the risk of saturation excess overland flow, high surface soil organic matter for optimum pesticide adsorption and degradation.
RZs and soluble reactive P (SRP) in subsurface flow	RZ efficiencies vary from negative (SRP source) to positive (SRP sink). Overall SRP abatement across a range of sites = 1.5%. Optimal conditions: aerobic conditions, as anaerobic conditions have been tied to SRP release in solution.
RZs and greenhouse gas (GHG) emissions at the soil–atmosphere interface	RZs generally present higher GHG emissions than their immediate upland environment. Intergovernmental Panel on Climate Change methods for N_2O edge-of-field emissions underestimate N_2O emissions in RZs. Optimal conditions: low temperatures tend to reduce CO_2 emission, wetland-like conditions tend to enhance CH_4 emission and turn the riparian zone from a CH_4 sink to a CH_4 source, high denitrification rates have been tied to enhanced N_2O emissions. Unless the riparian contains organic rich wet soils, emissions expressed in CO_2 equivalent are primarily tied to CO_2 emission.
RZs and Hg in subsurface flow	RZs are generally not hot spots of methylmercury production in the landscape, even in areas of significant atmospheric Hg deposition, unless they are peat-dominated wetlands or contain wet organic rich soils. Optimal conditions: high soil organic matter content in areas with high Hg atmospheric deposition has been tied to high soil Hg content. In those cases, high SO_4^{2-} concentrations, warm temperatures, and anoxic conditions have been tied to enhanced methylmercury production.
RZs and emerging contaminants	RZs are generally sinks for estrogens. If anoxic conditions dominate, they are often sinks for perchlorate. The impact of RZs on other types of emerging contaminants needs more research. Optimal conditions: extremely variable and dependent on individual contaminant. Vegetation (plant uptake), soil organic matter content (adsorption & degradat ... emerging contaminant removal.

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RIPARIAN BUFFER MANAGEMENT

Twenty Years of Riparian Zone Research (1997–2017): Where to Next?

Philippe G. Vidon,* Molly K. Welsh, and Yasaman T. Hassanzadeh

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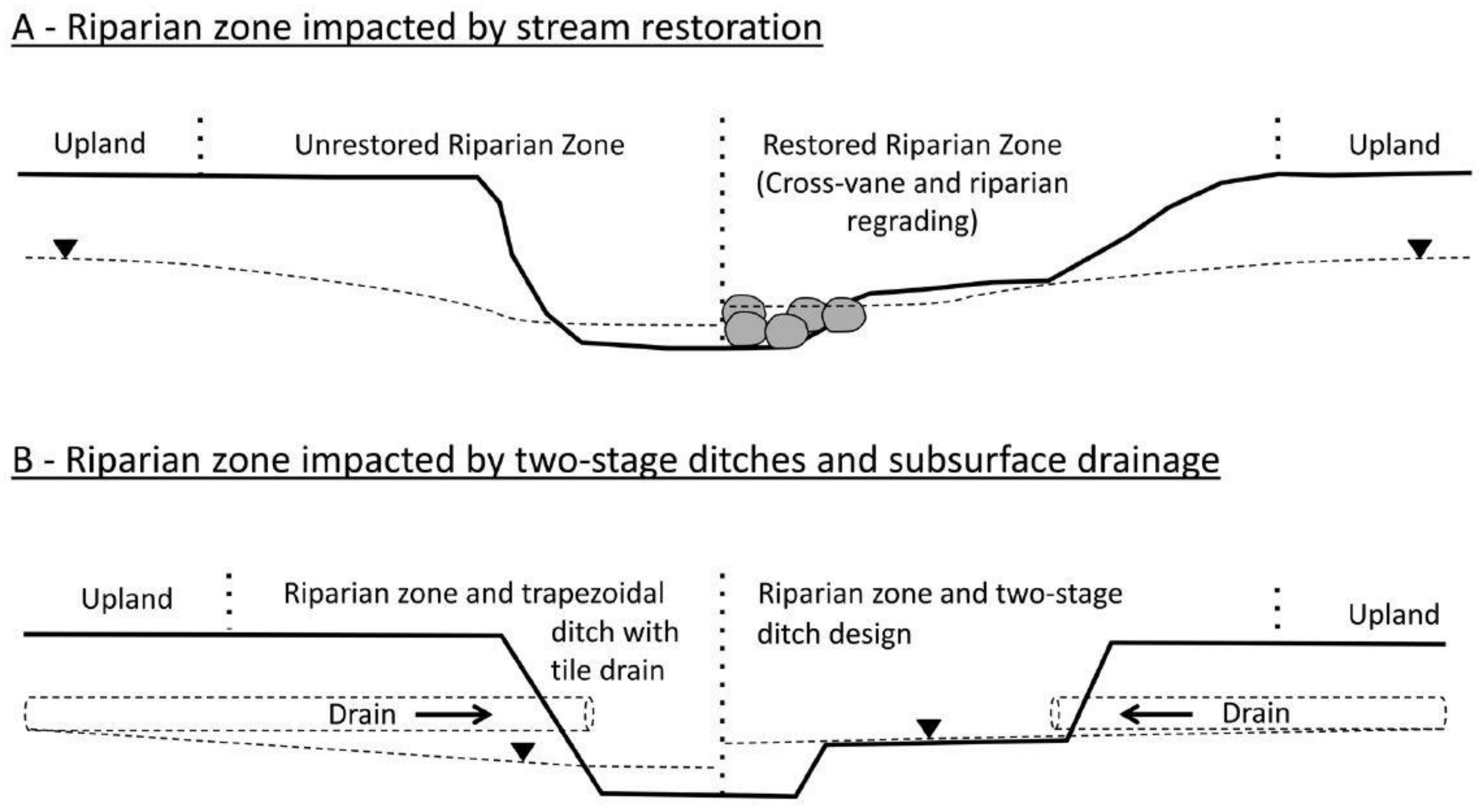

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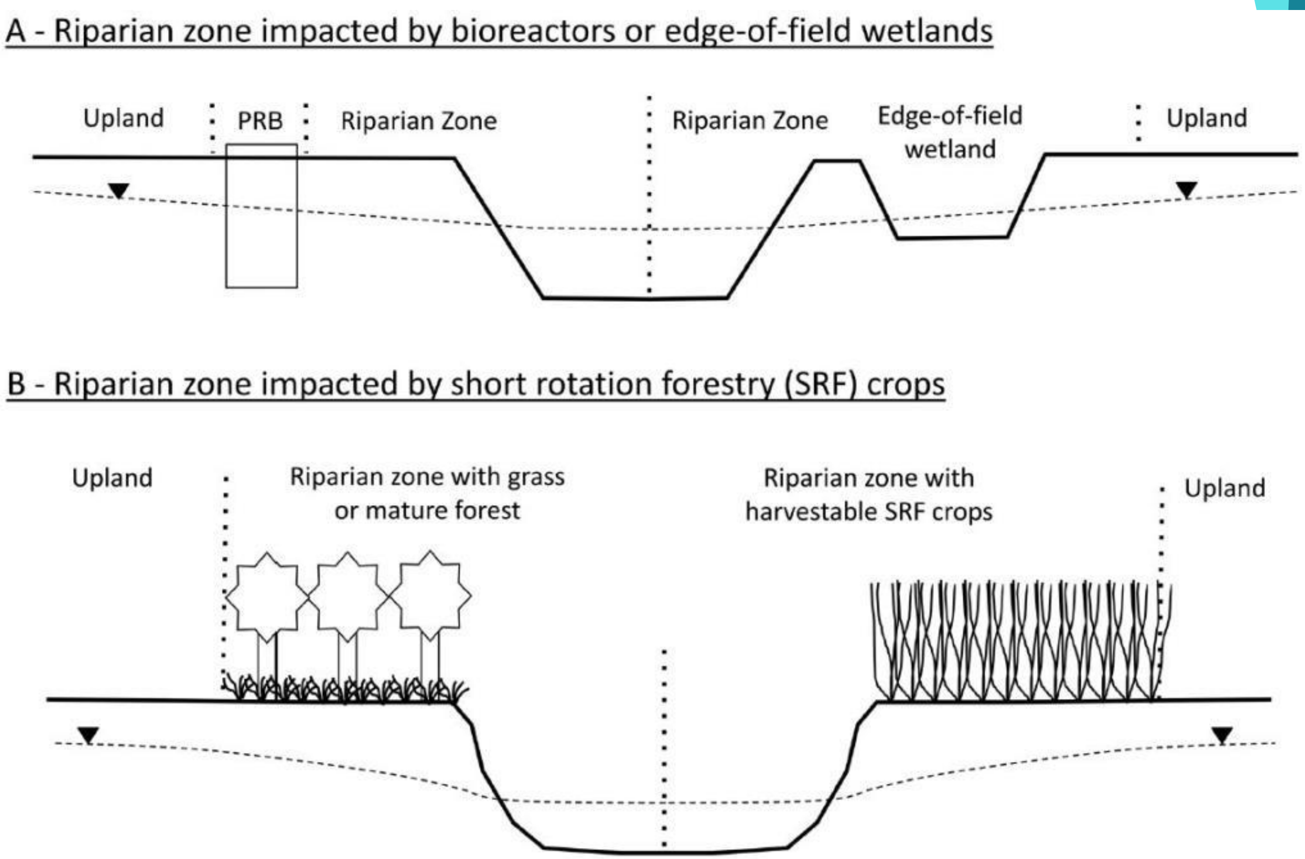

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Fascia tampone Scandolara

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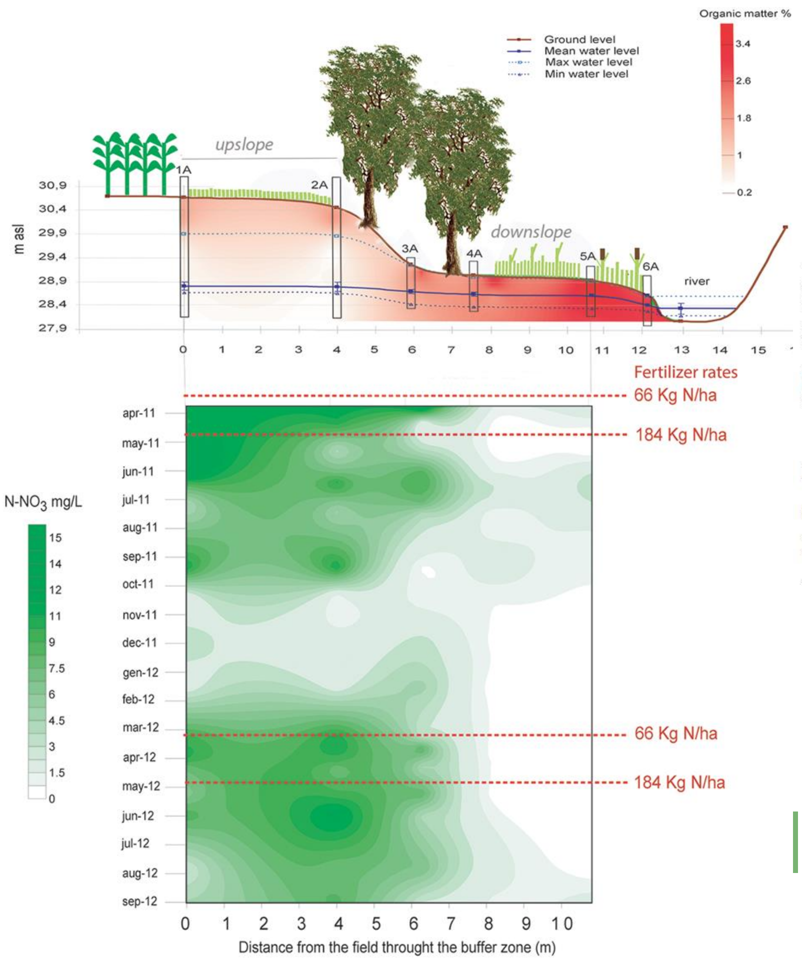
Fascia tampon Scandolara



Contents lists available at ScienceDirect

Ecological Engineering

journal homepage: www.elsevier.com/locate/ecoleng

How to stop nitrogen leaking from a Cross compliant buffer strip?

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lificazione fluviale

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Agricolo: Fitodepurazione

FWS Rusteghin (Veneto) – 3.5 ha

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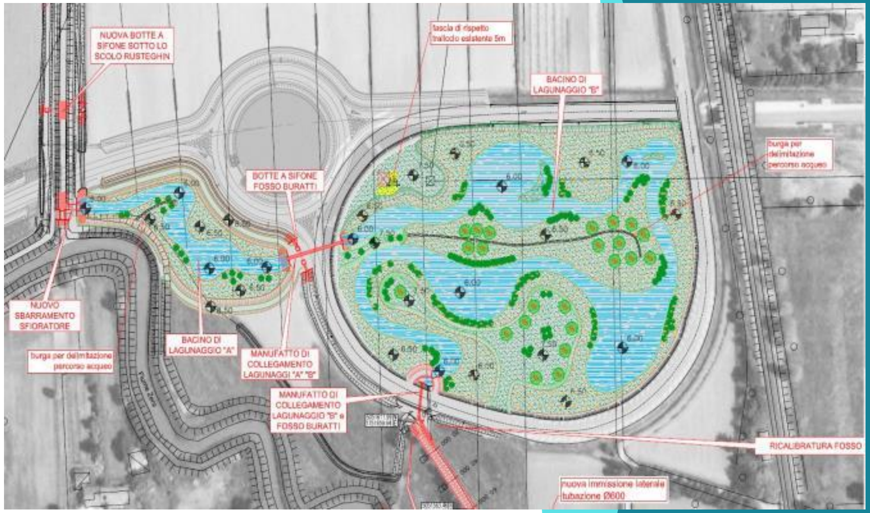

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Agricolo: Fitodepurazione

Oasi di Salzano (Veneto) – 21 ha

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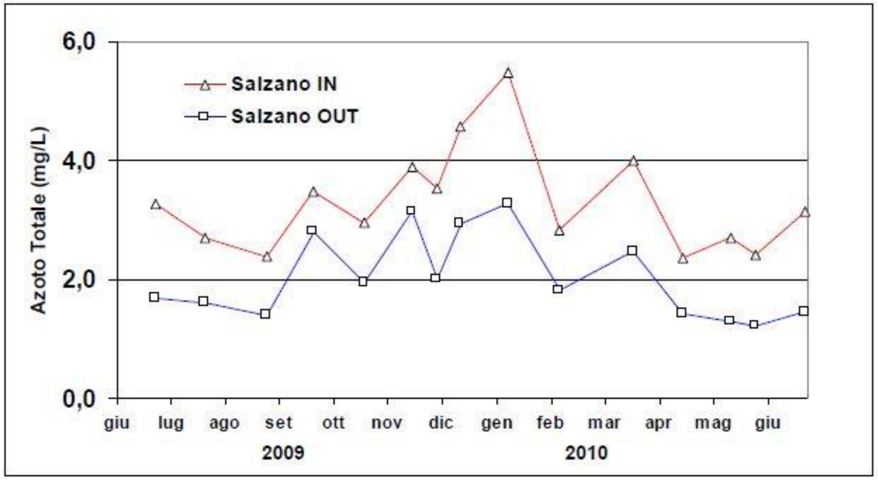
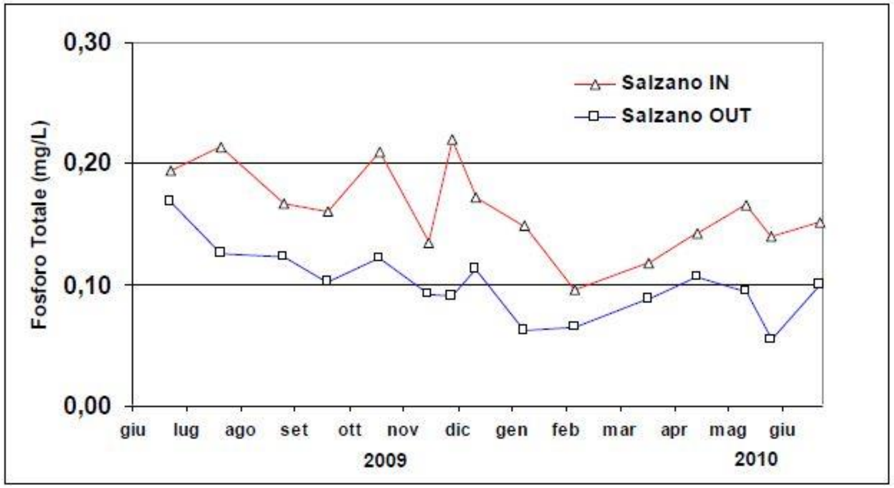
Agricolo: Fitodepurazione





N° 23 NBS tra fasce tampone e fitodepurazione
Stimate rimozioni di 48 tN/anno e 4 tP/anno
(JRC /IPR/2019/OP/0394)

European Commission

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Agricolo: Fitodepurazione

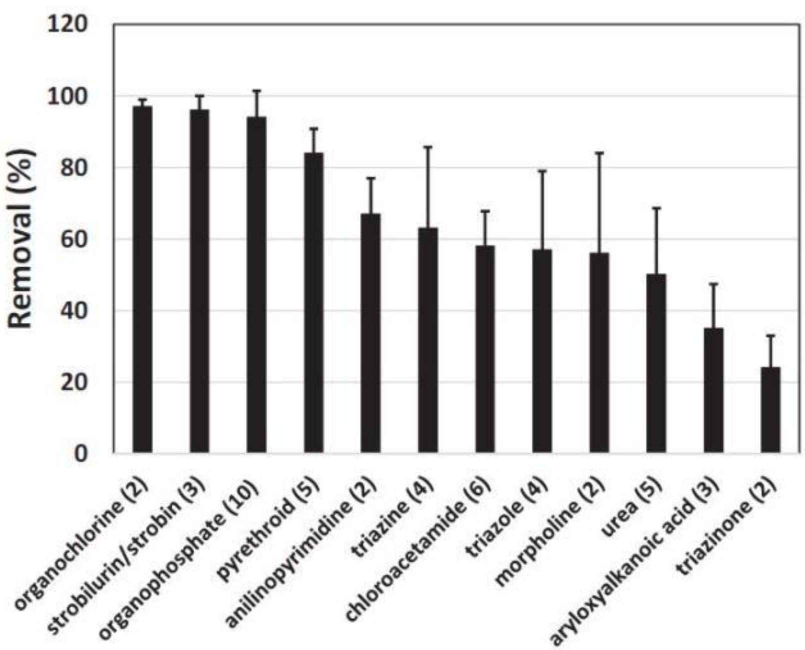

Fig. 1. Removal of pesticides according to the pesticide chemical groups. Numbers in parentheses indicate number of pesticides in each group.

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Review

The use of constructed wetlands for removal of pesticides from agricultural runoff and drainage: A review

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Journal of Environmental Management

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Research article

The role of constructed wetlands in a new circular economy, resource oriented, and ecosystem services paradigm

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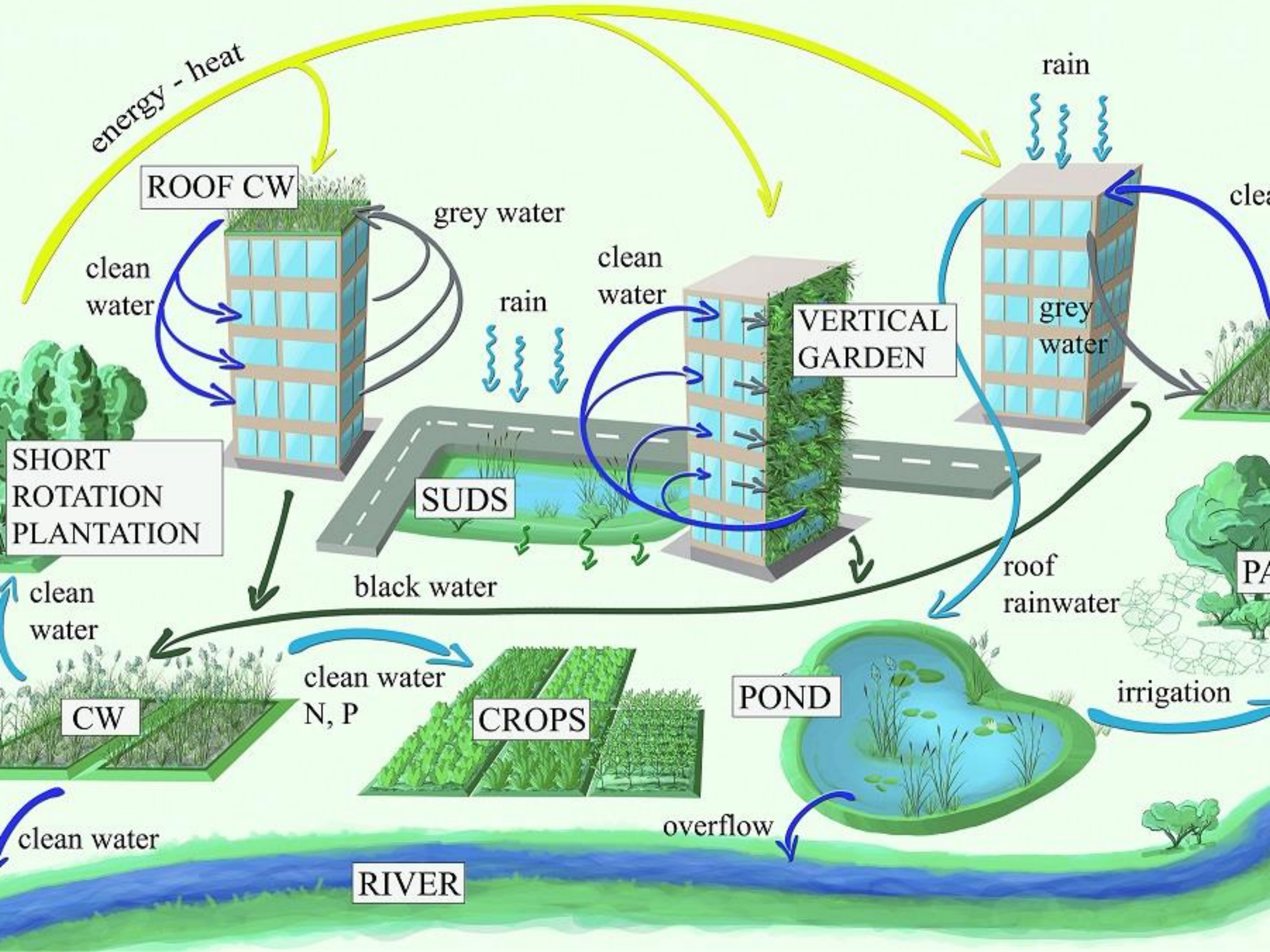
energy - heat
ROOF CW
grey water
clean water
rain
clean water
VERTICAL GARDEN
rain
grey water
SHORT ROTATION PLANTATION
SUDS
black water
roof rainwater
clean water
CW
clean water N, P
CROPS
POND
irrigation
overflow
clean water
RIVER

Grazie per l’attenzione

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