

# SESSIONE TEMATICA DI APPROFONDIMENTO

**Un patto per l'acqua:  
le molteplici funzioni della risorsa idrica  
nello scenario dei cambiamenti climatici**

## ***Gestione sostenibile delle acque e adattamento ai cambiamenti climatici con le Nature-based Solutions***

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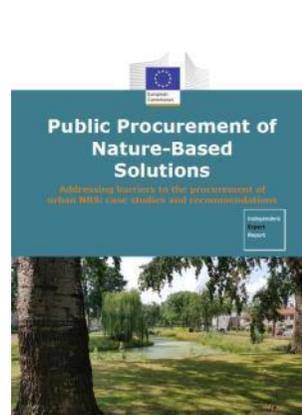
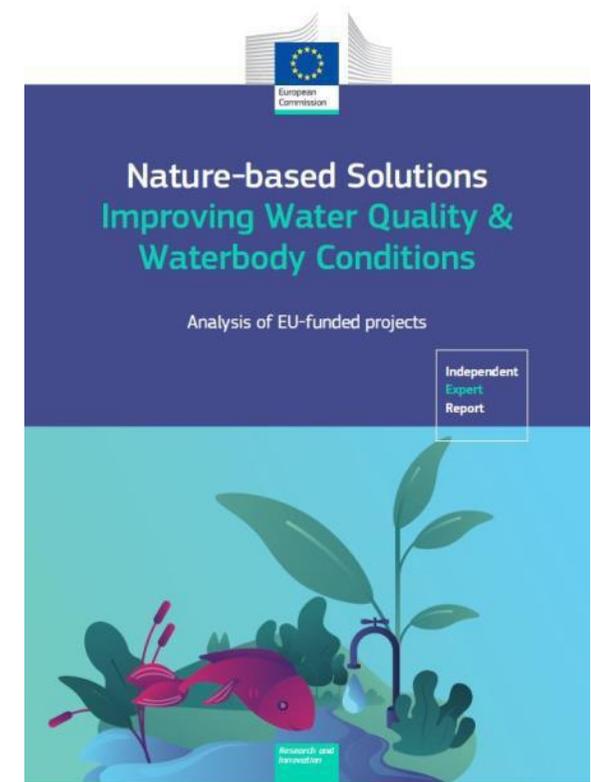


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# Interesse EU per le NBS



“La Commissione Europea definisce le **Nature-based Solutions (NbS)** come risposte alle sfide sociali che sono ispirate e sostenute dalla natura, che sono economicamente efficaci, forniscono simultaneamente benefici ambientali, sociali ed economici e aiutano a costruire la resilienza.”



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## Servizi di Consulenza e Ingegneria

- Pianificazione
- Studi di fattibilità
- PFTE, progettazione esecutiva
- Direzione lavori e sicurezza



R&D



RES EAU



NICE



Circular City  
circular-city.eu

UN URBINAT



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# IRIDRA: un team multidisciplinare



Nicola Martinuzzi.  
Mechanical Engineer



Fabio Masi,  
PhD Chemist



Giulio Conte  
Biologist



Riccardo Bresciani,  
Environmental  
Engineer



Ivano Filippini  
Land Surveyor



Barbara Bonadies  
Architect



Anacleto Rizzo  
Phd Hydraulic Engineer



Linda Sabatini  
Administration and  
Tender



Giordano Fossi  
Agronomist



Paolo Armanasco  
Agronomist



Kathryn Rivai  
Environmental  
Engineer



Chiara Sarti  
Chemist



Chiara Zurli  
Environmental  
Engineer



Michela Galletti  
Landscape architect



Riccardo Cilia  
Landscape architect  
and Codesign expert



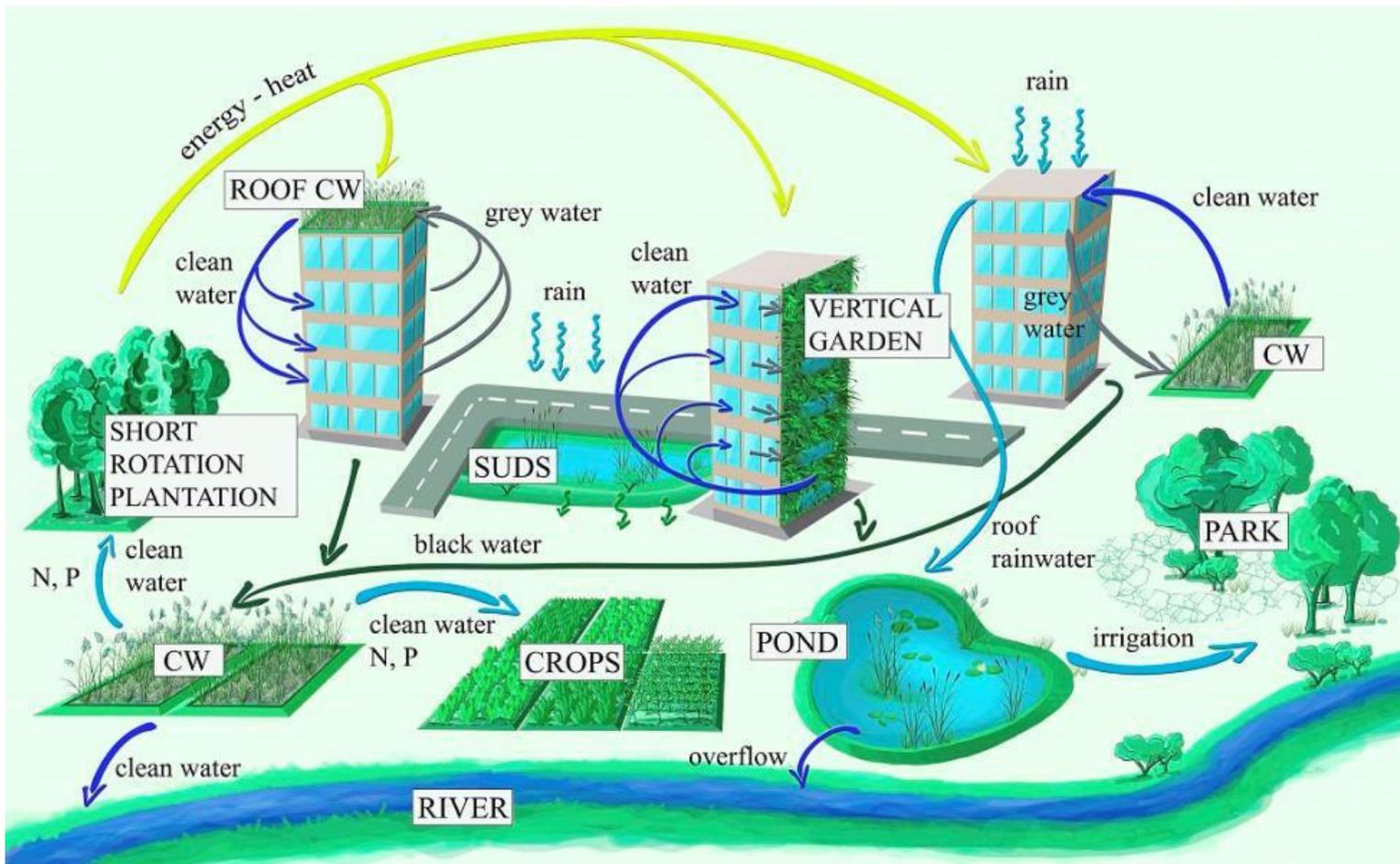
Francesco Leone  
Building Engineer



Iliara Principi  
Phd Chemist



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Contents lists available at ScienceDirect

Journal of Environmental Management

journal homepage: [www.elsevier.com/locate/jenvman](http://www.elsevier.com/locate/jenvman)



Research article

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

F. Masi <sup>a,\*</sup>, A. Rizzo <sup>a</sup>, M. Regelsberger <sup>b</sup>

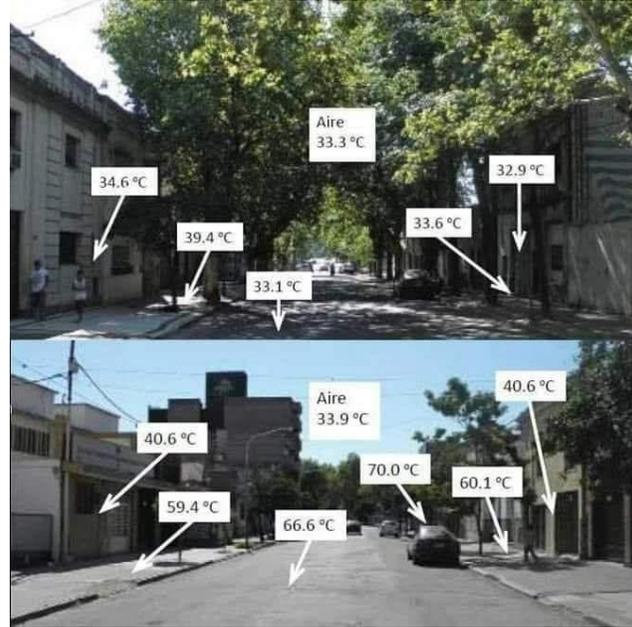
<sup>a</sup> IRIDRA Srl, Via La Marmorata 51, 50121, Florence, Italy

<sup>b</sup> Technisches Büro Regelsberger, Marburger Gasse 11, 8200, Gleisdorf, Austria

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# Ciclo acqua

## Cambiamenti climatici



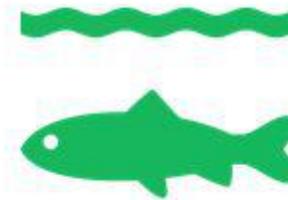
Biodiversity



Floods



Heat



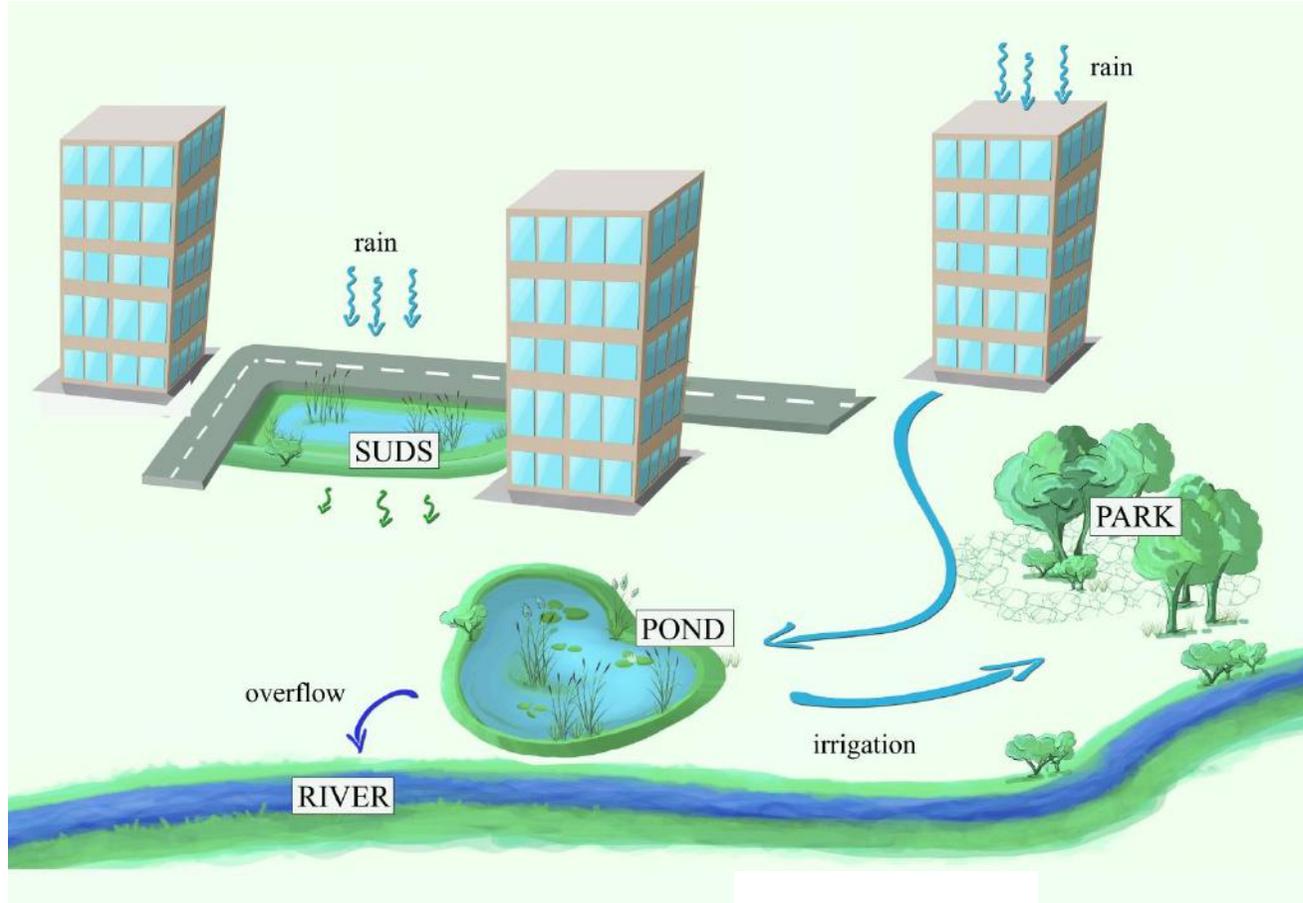
Water quality



Droughts

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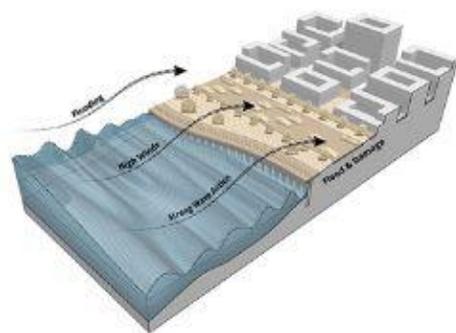
# Drenaggio Urbano Sostenibile



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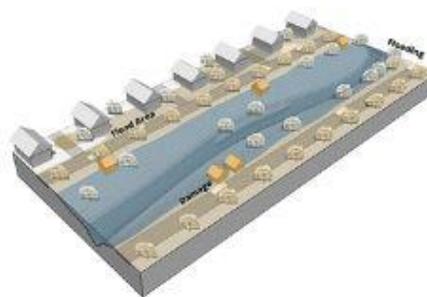
# Types of floods

<https://nrcsolutions.org/>



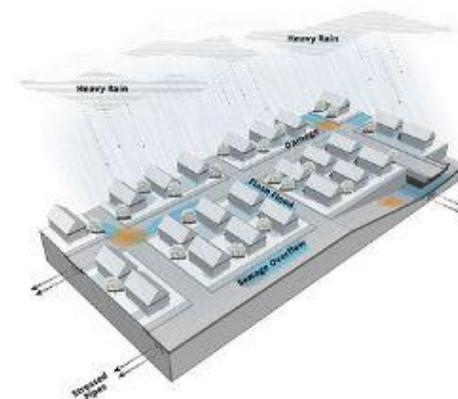
## COASTAL FLOODING

Flooding to coastal areas caused by waves / storm surge during a storm



## RIVERINE FLOODING

Flooding caused by high river levels



## STORMWATER FLOODING

Localized flooding in a community caused by heavy rains



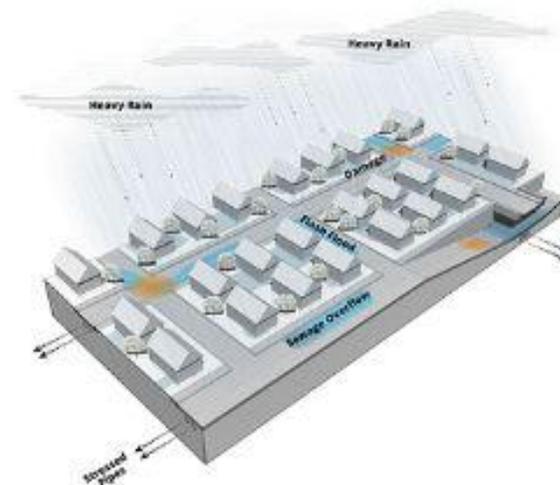
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# Raccolta della pioggia – SISTEMI NATURALI

## Drenaggio Urbano Sostenibile

Conosciuta con diverse parole chiave:

- SuDS Sustainable drainage systems
- WSUD Water Sensitive Urban Design
- LID Low impact development
- BMP Best management practices



### STORMWATER FLOODING

Localized flooding in a community caused by heavy rains

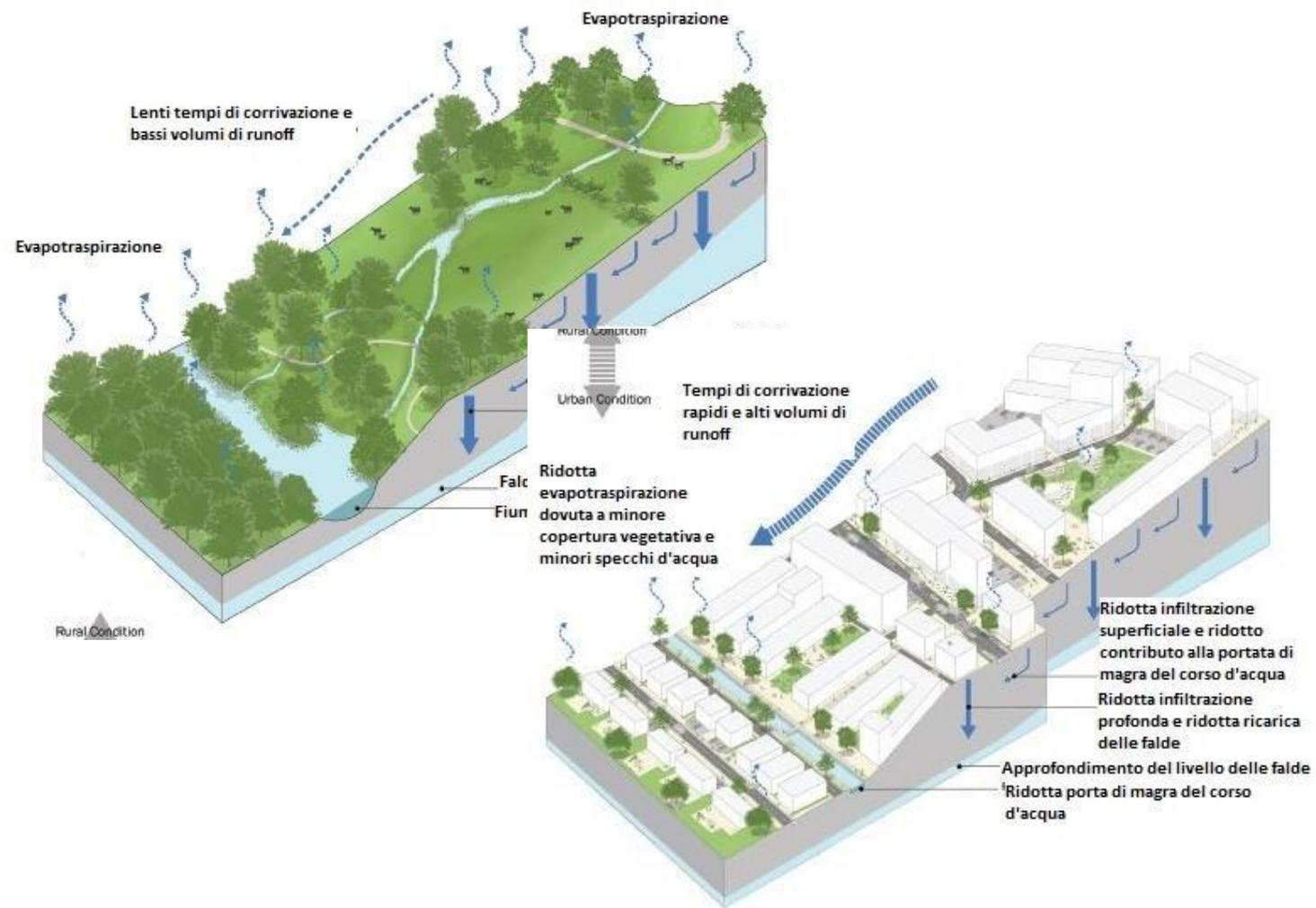
*Urban Water Journal*, 2014

<http://dx.doi.org/10.1080/1573062X.2014.916314>

### RESEARCH ARTICLE

## SUDS, LID, BMPs, WSUD and more – The evolution and application of terminology surrounding urban drainage

Tim D. Fletcher<sup>a\*</sup>, William Shuster<sup>b</sup>, William F. Hunt<sup>c</sup>, Richard Ashley<sup>d</sup>, David Butler<sup>e</sup>, Scott Arthur<sup>f</sup>, Sam Trowsdale<sup>g</sup>, Sylvie Barraud<sup>h</sup>, Annette Semadeni-Davies<sup>i</sup>, Jean-Luc Bertrand-Krajewski<sup>h</sup>, Peter Steen Mikkelsen<sup>j</sup>, Gilles Rivard<sup>k</sup>, Mathias Uhl<sup>l</sup>, Danielle Dagenais<sup>m</sup> and Maria Viklander<sup>n</sup>



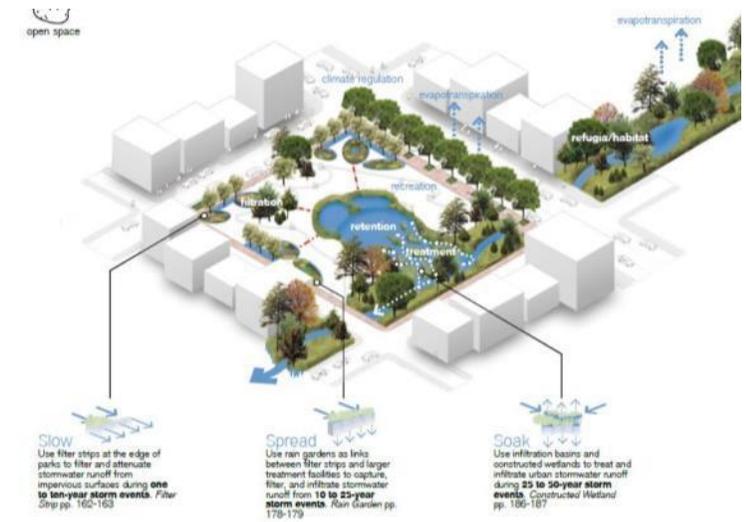
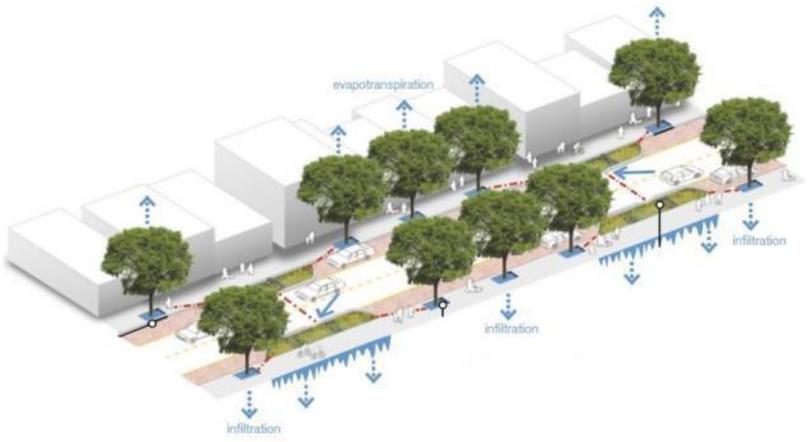
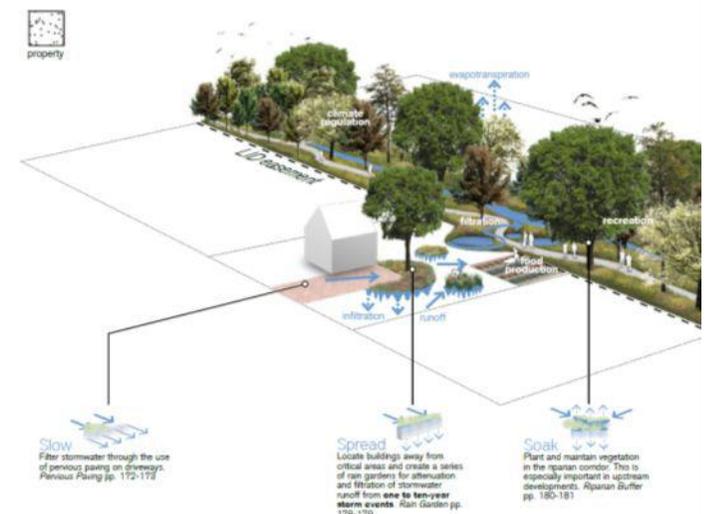
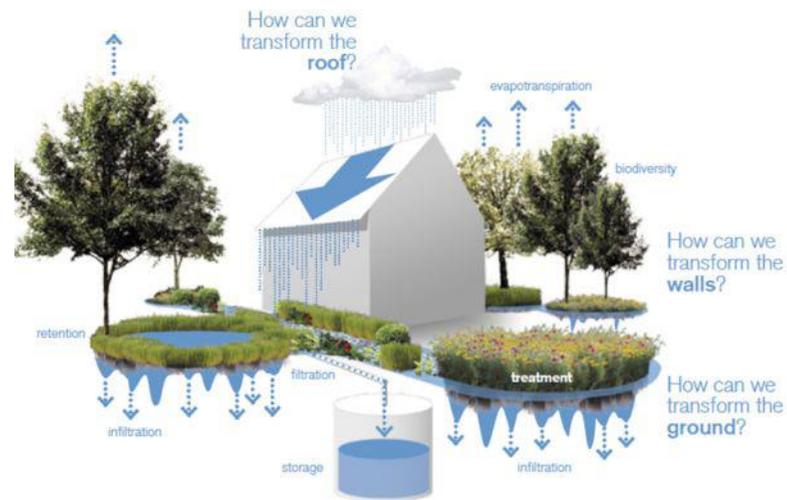
Fonte: Woods Ballard et al. 2015. "The SuDS Manual"



Fonte: Woods Ballard et al. 2015. "The SuDS Manual"

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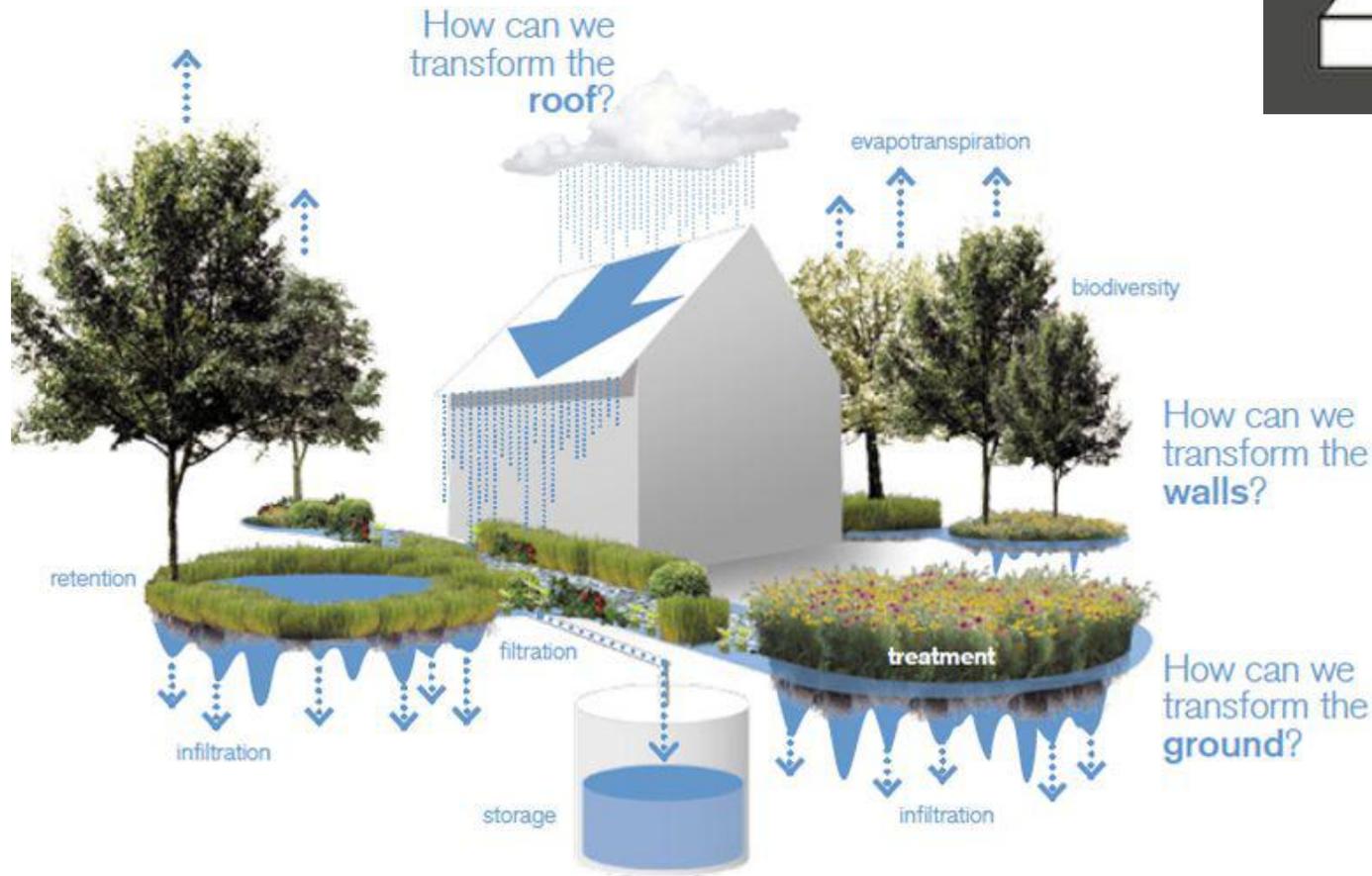
# SuDS e scale di applicazione



Fonte: Huber, J., 2010. *Low Impact Development: a Design Manual for Urban Areas*

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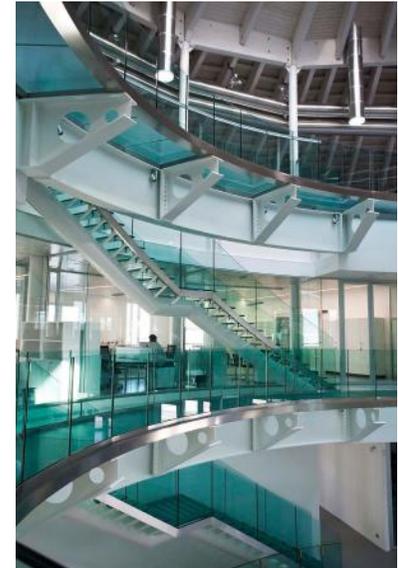
# Singola abitazione o edificio



Fonte: Huber, J., 2010. *Low Impact Development: a Design Manual for Urban Areas*

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# Research centre Kerakoll, Sassuolo (Italy)



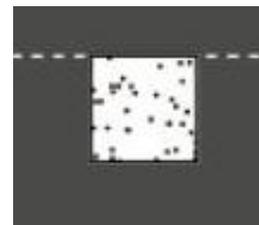




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# Le scale di applicazione

## Parcheeggi: Pixellato



Fonte: Huber, J., 2010. *Low Impact Development: a Design Manual for Urban Areas*

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# Città Metropolitana Milano Spugna



- Fondi PNRR, 92 Interventi in 4 lotti progettuali
- Lotto 2 (26 interventi). Progettazione DEF IRIDRA – retrofitting SuDS strade e parcheggi

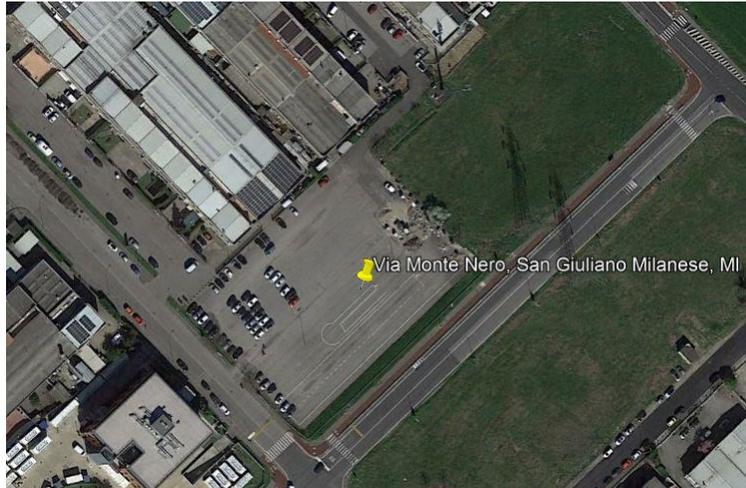


Città  
metropolitana  
di Milano



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# Città Metropolitana Milano Spugna S. Giuliano Milanese – Via Monte Nero

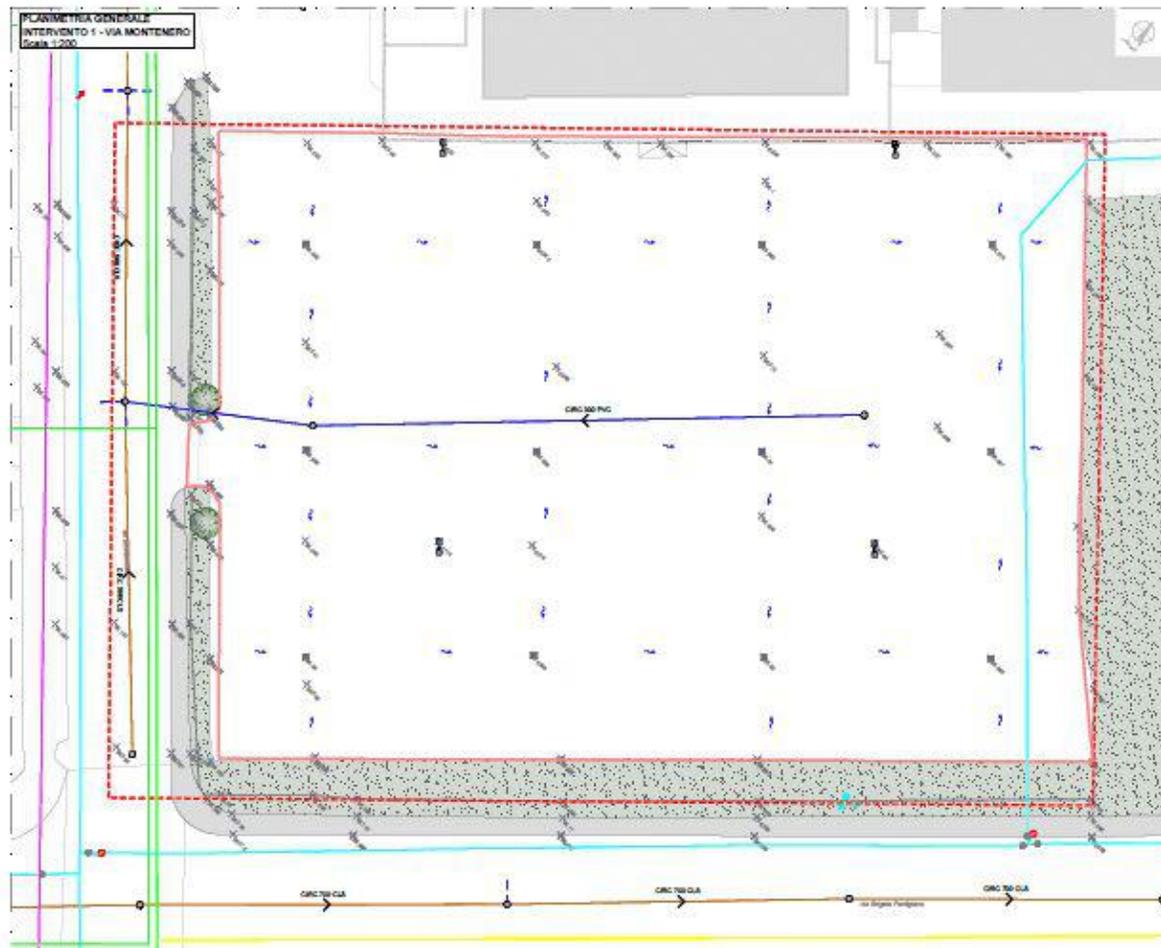


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# Città Metropolitana Milano Spugna

## Pieve Emanuele – Piazza Allende

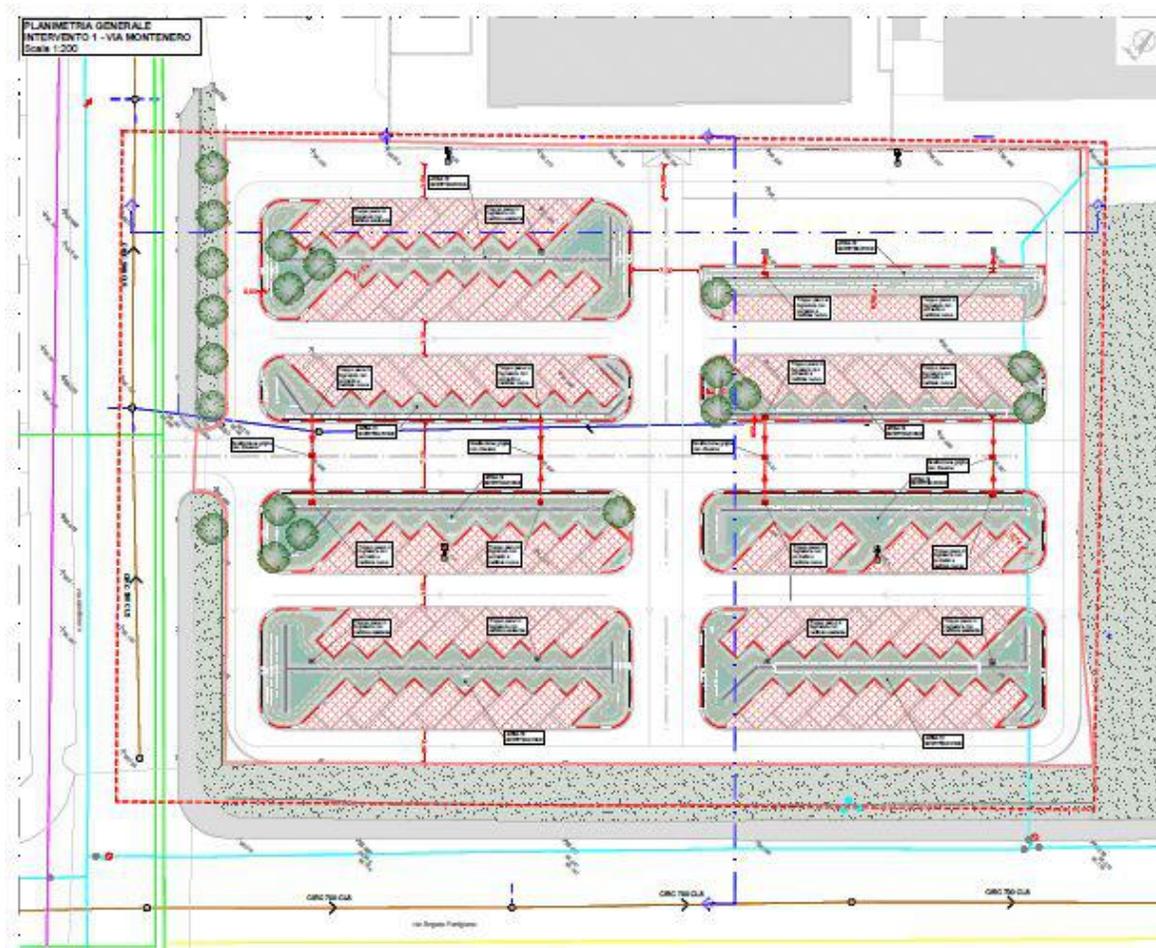
Stato di Fatto



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# Città Metropolitana Milano Spugna Pieve Emanuele – Piazza Allende

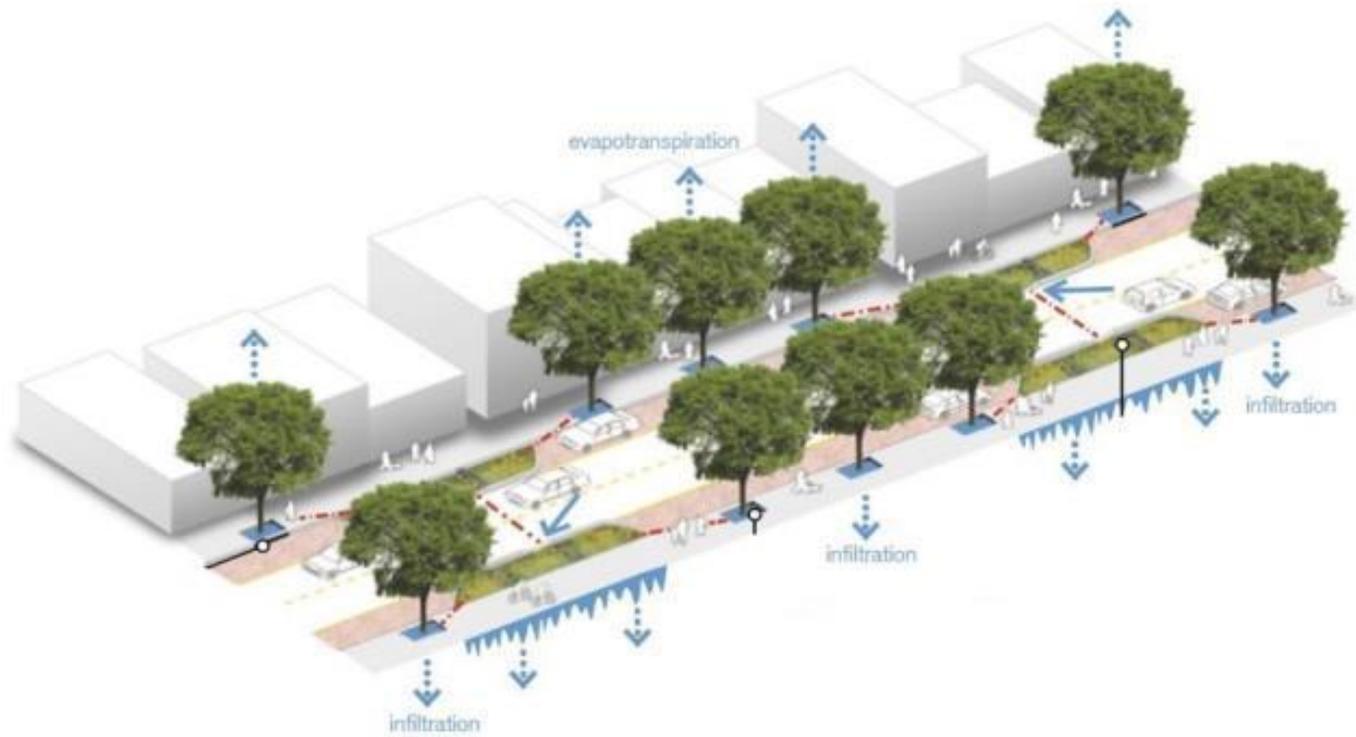
## Stato di Progetto



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# Le scale di applicazione

## Strade



Fonte: Huber, J., 2010. *Low Impact Development: a Design Manual for Urban Areas*

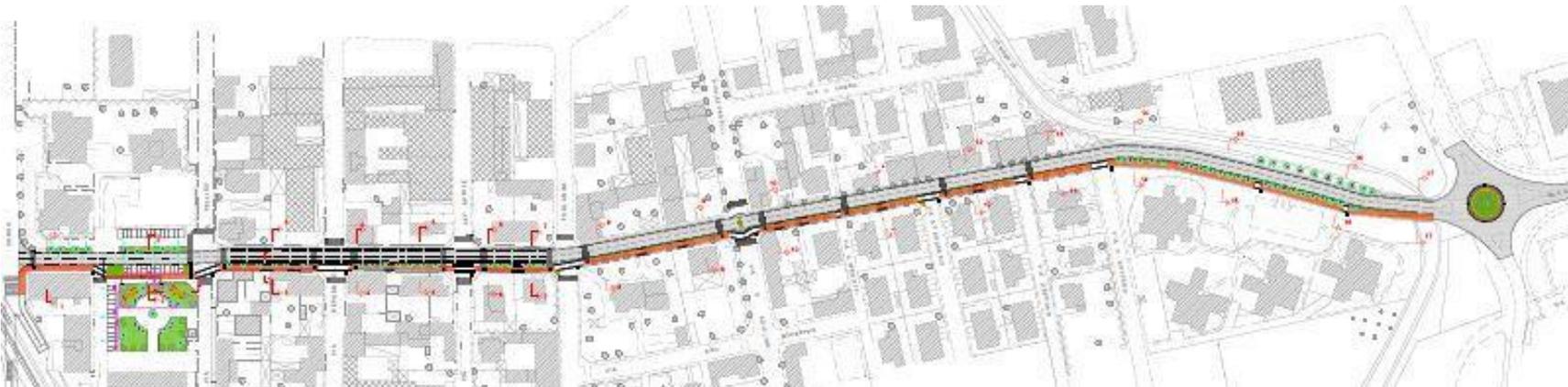
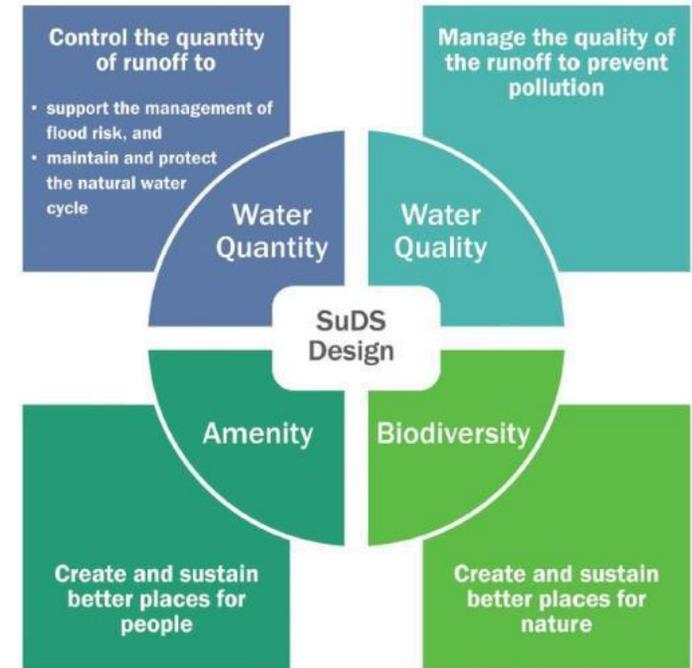
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# Viale Matteotti, Bovisio Masciago (MB)

## Planimetria

Intervento multiobiettivo di retrofitting SuDS, al posto della semplice posa di una pavimentazione permeabile, è stata riqualificata e rinverdita circa 1 km di strada con 1000 m<sup>2</sup> di aree di bioritezione e una pista ciclabile

Budget: circa **1,000,000.00 €** per i costi di costruzione



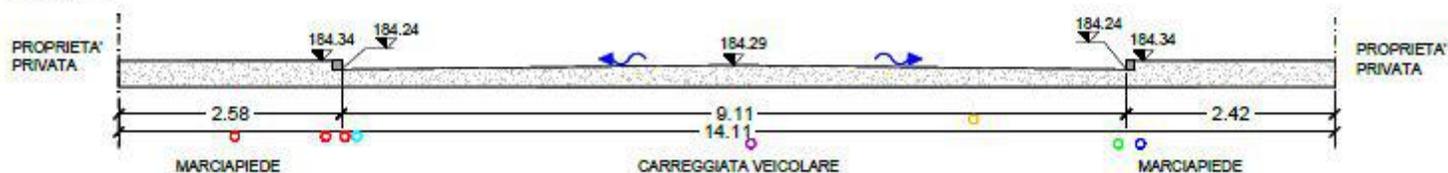
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# Viale Matteotti, Bovisio Masciago (MB)

## Viale Giacomo Matteotti

SEZIONE 25-25 - VIA GIACOMO MATTEOTTI - STATO DI FATTO

Scala 1:50



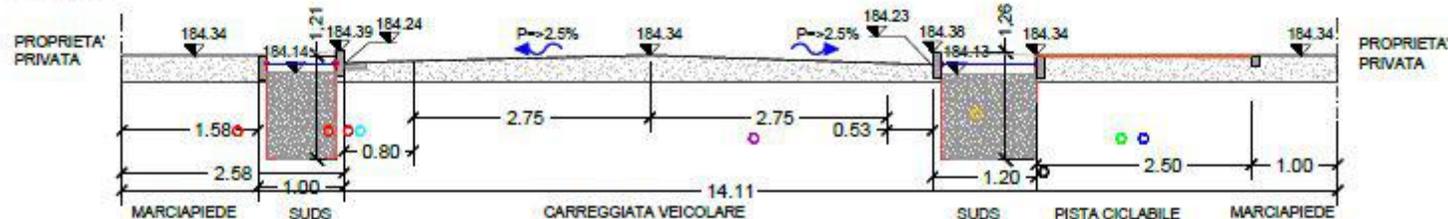
SEZIONE 25-25 - VIA GIACOMO MATTEOTTI - STATO SOVRAPPOSTO

Scala 1:50



SEZIONE 25-25 - VIA GIACOMO MATTEOTTI - STATO DI PROGETTO

Scala 1:50





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# Viale Matteotti, Bovisio Masciago (MB)

## Laboratorio urbano di retrofitting SuDS



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# Viale Matteotti, Bovisio Masciago (MB)

## Laboratorio urbano di retrofitting SuDS



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# Viale Matteotti, Bovisio Masciago (MB)

## Laboratorio urbano di retrofitting SuDS



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# Spazi aperti pubblici

## Piazze e Parchi

open space



### Slow

Use filter strips at the edge of parks to filter and attenuate stormwater runoff from impervious surfaces during **one to ten-year storm events**. *Filter Strip* pp. 162-163

### Spread

Use rain gardens as links between filter strips and larger treatment facilities to capture, filter, and infiltrate stormwater runoff from **10 to 25-year storm events**. *Rain Garden* pp. 178-179

### Soak

Use infiltration basins and constructed wetlands to treat and infiltrate urban stormwater runoff during **25 to 50-year storm events**. *Constructed Wetland* pp. 186-187

Fonte: Huber, J., 2010. *Low Impact Development: a Design Manual for Urban Areas*

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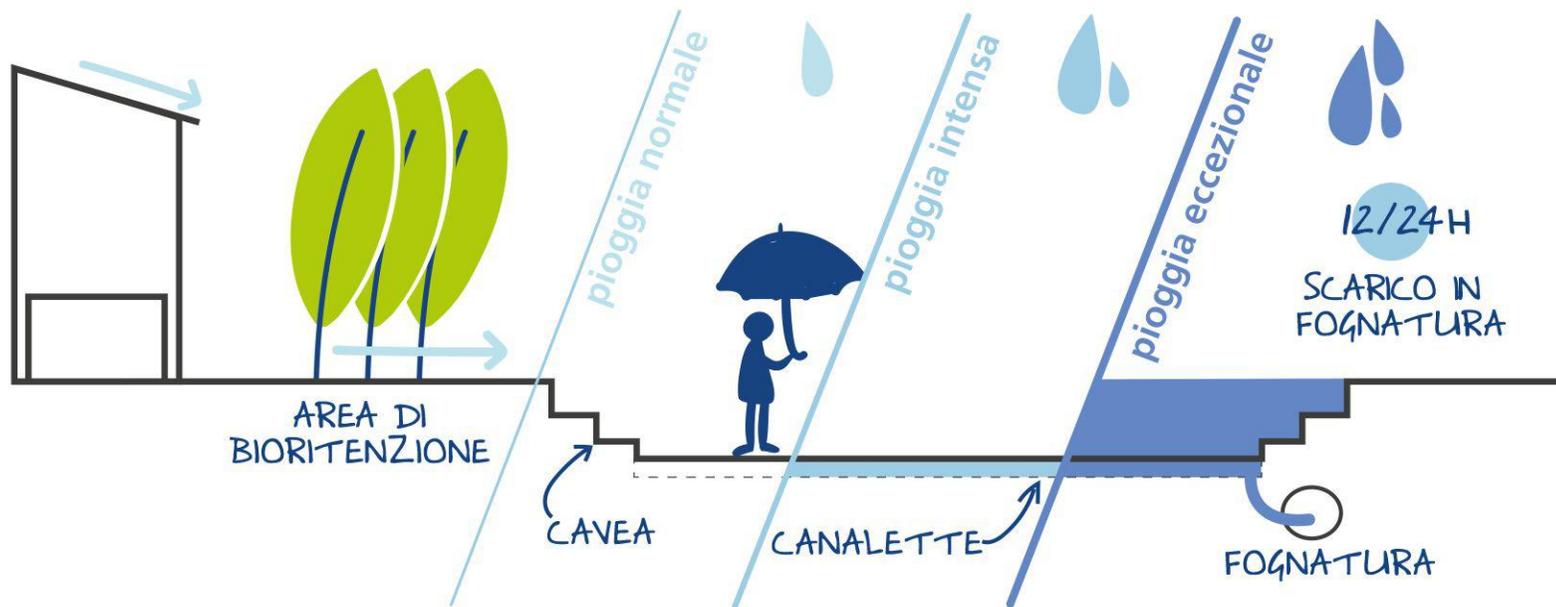
# Viale Matteotti, Bovisio Masciago (MB)

## Cantiere (inaugurazione 15 Aprile 2023)



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# Water Plaza, Agrate Brianza



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# Water Plaza, Agrate Brianza



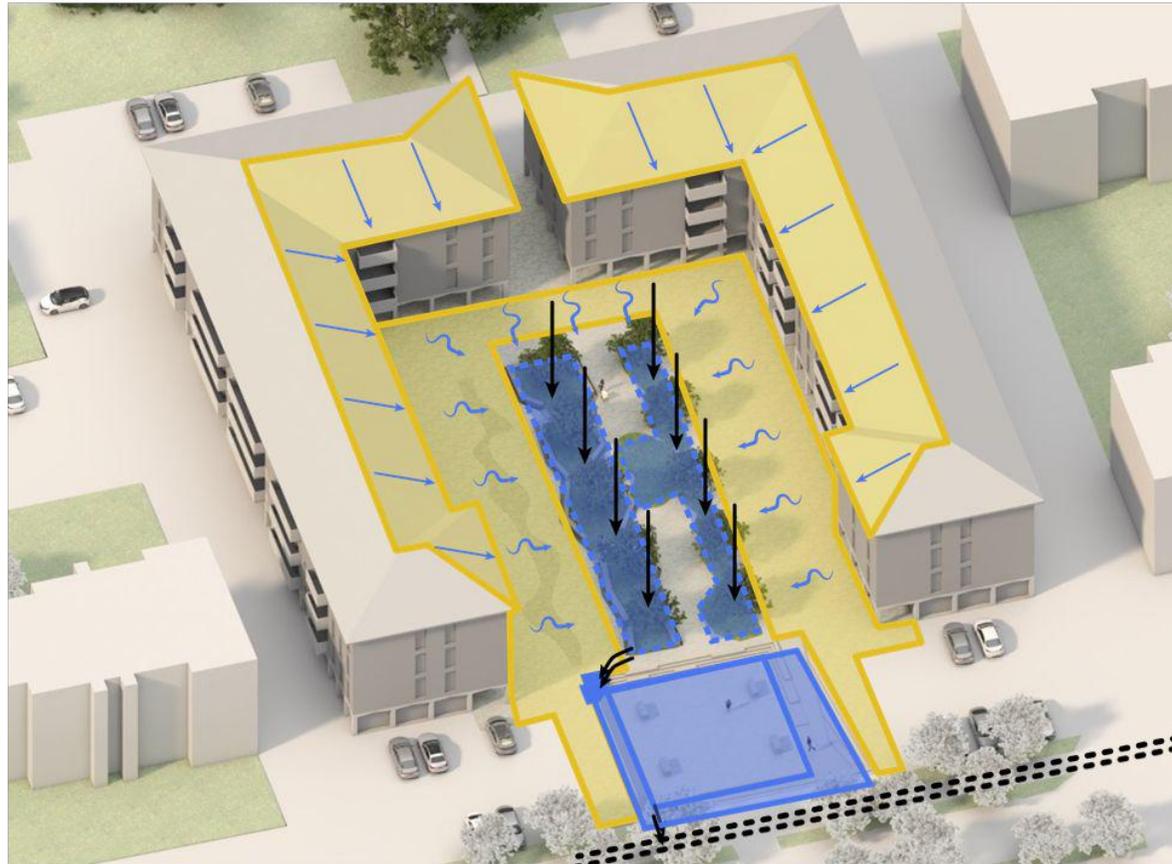
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# Water Plaza, Agrate Brianza

Area di accumulo

Superficie drenata

Area di infiltrazione



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# Sfioratori da fognatura mista



**MULTISOURCE**  
enhanced natural treatment solutions



CSO treatment wetland of Carimate (Italy) – Design IRIDRA

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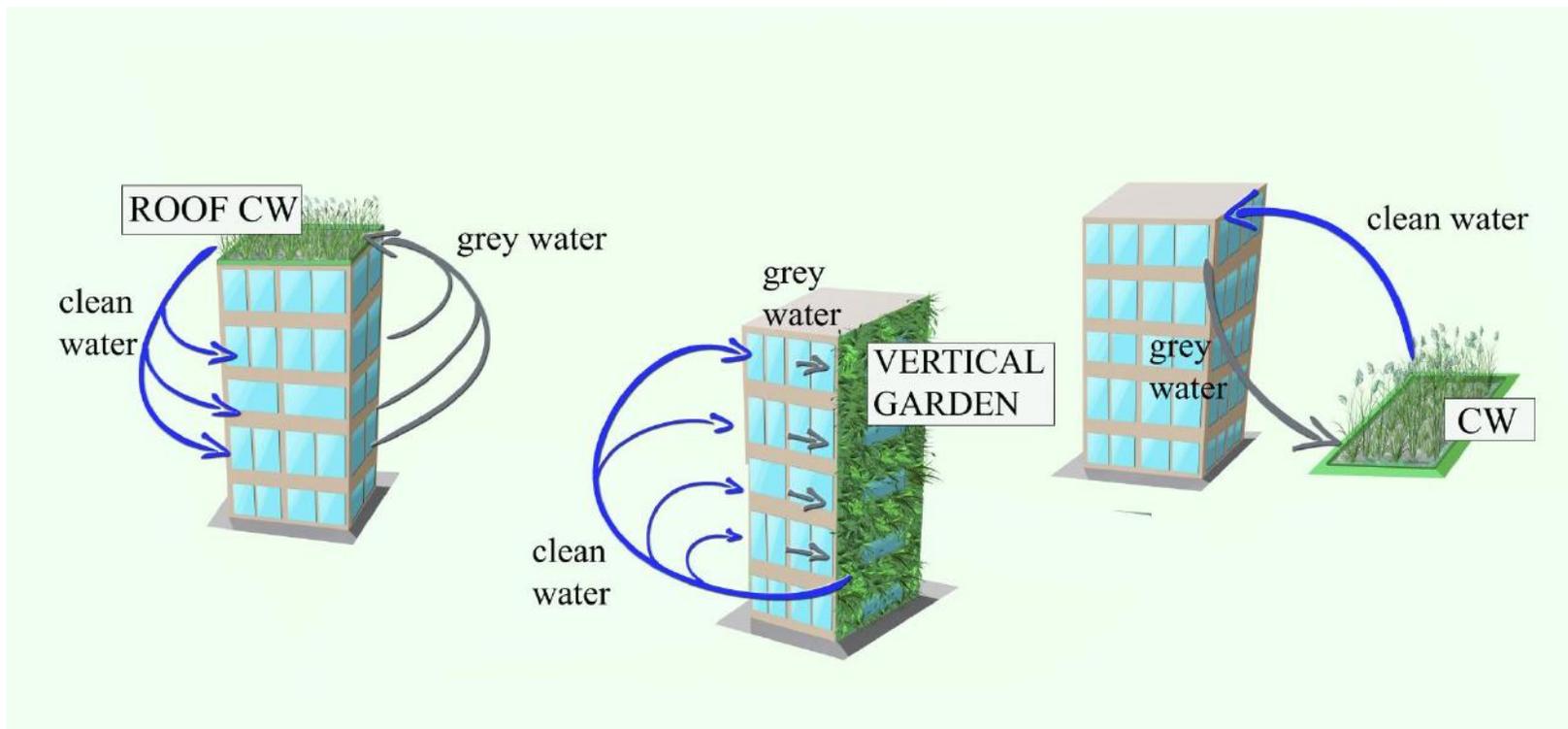
# Sfioratori da fognatura mista

## Parco dell'acqua di Gorla Maggiore



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# Trattamento e recupero acque grigie



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# NBS trattamento e riuso delle acque grigie

## Fitodepurazione: outdoor



**Area residenziale**

**Preganziol (TV - Italy)**

280 abitanti

Separazione, trattamento,  
riuso acque grigie per ricarica  
cassette WC



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# NBS trattamento e riuso delle acque grigie

## Fitodepurazione: outdoor

**Hostel campus of the College of Engineering, Pune (India)**

- Acque grigie trattate: 40 m<sup>3</sup>/day
- Separazione, trattamento, riuso acque grigie per ricarica cassette WC



**NaWaTech**

Natural Water Systems and Treatment  
Technologies to cope with Water  
Shortages in urbanised Areas in India



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# NBS trattamento e riuso delle acque grigie

## Tetti verdi



**Resort in Grumentoni  
community, Sergenti  
(Tanzania)**

4 mc/g

Separazione, trattamento, riuso  
acque grigie per irrigazione



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# NBS trattamento e riuso delle acque grigie

## Muri verdi



Beirut (Lebanon)



Tunis (Tunisia)





*Ferla (Sicilia, Italia)*

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# NBS trattamento e riuso delle acque grigie

## Muri verdi



 NAWAMED

 sviimed.  
centro euromediterraneo  
per lo sviluppo sostenibile onlus

[https://www.youtube.com/@Gocce.Di.Rugiada\\_FILM/videos](https://www.youtube.com/@Gocce.Di.Rugiada_FILM/videos)

 IRIDRA  
S.r.l.

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# Food-Energy-Water



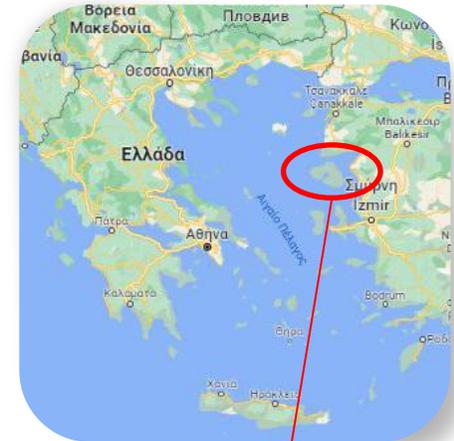
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# Food-Energy-Nexus con le NBS Lesbo (Grecia)

- Villaggio di **Antissa**, isola di Lesvos, Grecia
- **Attività agricola**
- Reattore anaerobico (Up-flow Anaerobic Sludge Blanket - UASB) accoppiato a un sistema di fitodepurazione a flusso subsuperficiale verticale a due stadi (VSSF CW) per il **trattamento delle acque reflue** di un piccolo villaggio, 500-1000 abitanti (**HYDRO 1**) e la **fertirrigazione** di un campo agroforestale (**HYDRO 2**)
- **Effetti stagionali** e loro impatto sulla rimozione degli inquinanti inclusi nel regolamento UE sul riutilizzo dell'acqua (2020/741) e sui nutrienti



*European Union Horizon 2020 research and innovation programme under Grant Agreement No. 776643*



# Food-Energy-Nexus con le NBS

## Lesbo (Grecia)



**Q: 10 – 100 m<sup>3</sup>/d; area UASB: 30 m<sup>2</sup>; area CW: 850 m<sup>2</sup> (virca 2 m<sup>2</sup>/PE)**  
**Qualità dell'effluente finale (Classe A EU regolamento 2020/741 riuso dell'acqua)**  
**Classe A: BOD ≤ 10 mg/L, TSS ≤ 10 mg/L, E.Coli ≤ 10 /100 mL, Turbidity ≤ 5 NTU**



# Food-Energy-Nexus con le NBS

## HYDRO2

### Agroforesteria

- 1 ha
- > 3500 piante esistenti
- > 55 specie di piante
- Alberi, piante aromatiche, arbusti, ortaggi



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# Food-Energy-Nexus con le NBS

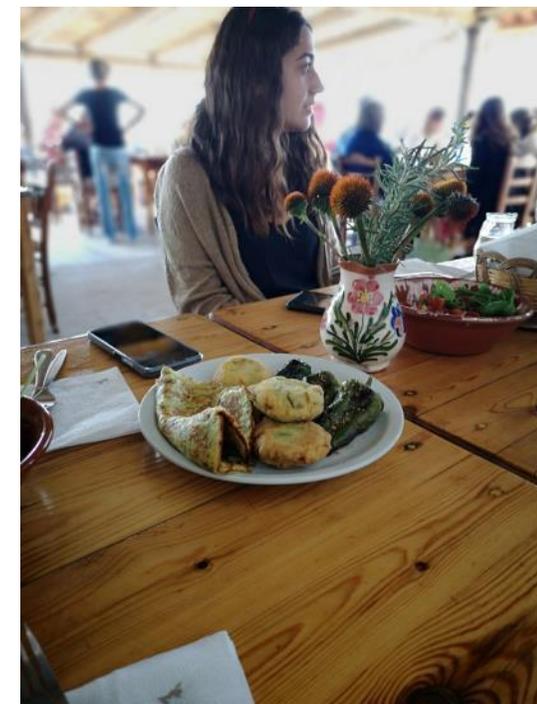
## HYDRO2



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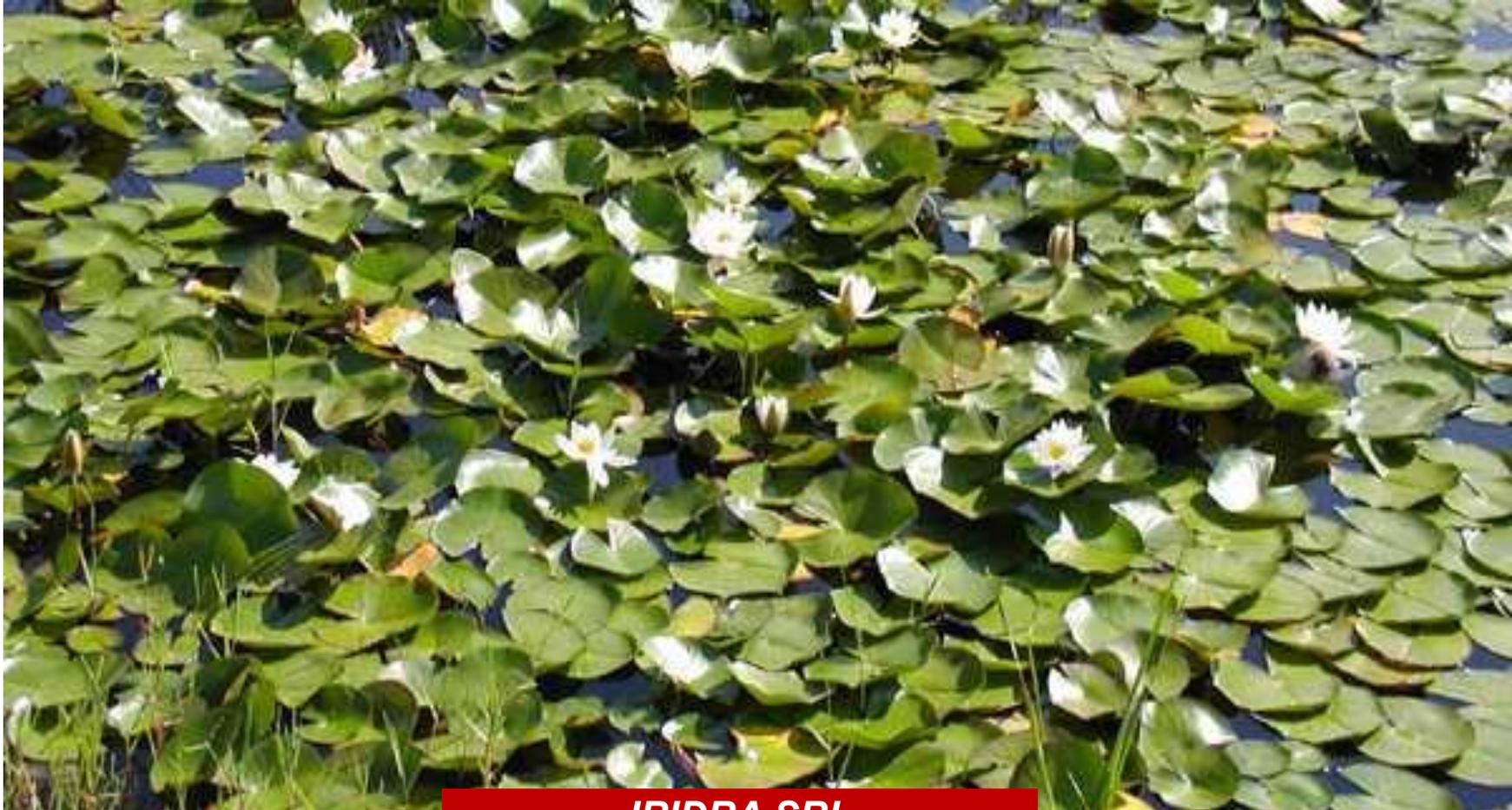
# Food-Energy-Nexus con le NBS

## HYDRO2



**Uso sicuro del cibo nel mercato locale (pranzo sociale a Skala Eressos di settembre 2021)**

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**IRIDRA SRL**

**Fitodepurazione, gestione sostenibile delle acque, soluzioni  
basate sulla natura e drenaggio urbano sostenibile**

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