REGIONE LAZIO

AIAPP
Associazione Italiana di Architettura del Paesaggio

IFLA EUROPE
INTERNATIONAL FEDERATION OF LANDSCAPE ARCHITECTS
PEARL JUBILEE 30 YEARS CARING FOR LANDSCAPE

STORMWATER MANAGEMENT

Climate change and new solutions for water management in the city

DESIGNING CHANGE

This booklet was made on the occasion of the event held in Rome on May22nd 2019:
Water Management: laboratorio Aniene
with a contribution of the Lazio Region pursuant to the Regional Regulations n. 19 of July 17th 2018.
Notice of the Determination n. G13950 of 05/11/2018, n. 17852 of 10/31/2018 (Period: February 1st – May 31st, 2019).
Scientific committee: Simone Amantia Scuderi, Gianni Celestini, Maria Cristina Tullio, Uta Zorzi Mühlmann
Coordination of the event on May 22nd 2019: Maria Cristina Tullio, Uta Zorzi Mühlmann

Outcome of the event and related activities:
Designing Change
Stormwater management – Climate change and new solutions for water management in the city

Curator: Uta Zorzi Mühlmann
Scientific supervision: Simone Amantia Scuderi
Contents: Simone Amantia Scuderi, Francesca Neonato, Vincenzo Perrone, Maria Cristina Tullio
Infografics: Simone Amantia Scuderi, Mattia Proietti Tocca
Editorial design and coordination: Vincenzo Perrone
Graphic design and layout: Gianluca Soddu
Translation to English version: Carmiella Salzberg
Edited by: AIAPP, Associazione Italiana Architettura del Paesaggio, with the scientific contribution of the *IFLA Europe Med_net working group*

INTRODUCTION

In 2002, at the Johannesburg World Conference for Sustainable Development, Nelson Mandela stated that "*Without water there is no future. Water is democracy.*" Since then, floods and droughts have been happening all over the planet... Overcoming or mitigating such disasters must certainly take place with global solutions but also with timely technological planning and landscape design measures, as well as spreading a new "culture of water." Surely, today, we can consider consolidated in the populations a greater awareness of the critical issues that are taking place, especially on the topic of climate. At the same time, there are now more and more known technical solutions that have been successfully tested internationally in the field of climate issues. It is increasingly urgent to activate concrete actions and train technicians and administrators on these issues, therefore increasing a "culture of water management".

With this purpose, and thanks to funding from the Lazio Region, AIAPP (Italian Association of Landscape Architecture) conducted an application experience in the territory of the Third Municipality in Rome, on the theme "WATER MANAGEMENT: LABORATORIO ANIENE". AIAPP has initiated an international comparison in collaboration with IFLA Europe (International Federation of Landscape Architects) and drafted the following publication.

The purpose of the event and applied research is that of spreading awareness and information, based on experience, about responsible water management practices and constructive technical solutions that allow us to better respond to critical issues generated by changes in global climate, the pollution of waterways and aquifers, excessive waterproofing of soil, and wastage. This event and research focuses on a management model centered on the recovery and reuse of water and maintaining high quality standards of this resource. This today means a "culture of water management".

> turn page

Why Rome and the territory of the Aniene river?

In Rome the Aniene enters the Tiber in the 3rd Municipality, and this last stretch of river flow crosses a densely built area (about 200,000 inhabitants). The relationship with water is structural for any territory and characterizes its landscape, but in Lazio, waterways such as the Aniene and the Tiber rivers, lakes, springs etc. are also elements of historical and symbolic importance. They have allowed expressions of architecture, landscaping and art of undeniable interest, not only on a national level. Examples include Roman aqueducts or areas such as the Villa d'Este and Villa Gregoriana in Tivoli, which are crossed by the course of the Aniene.

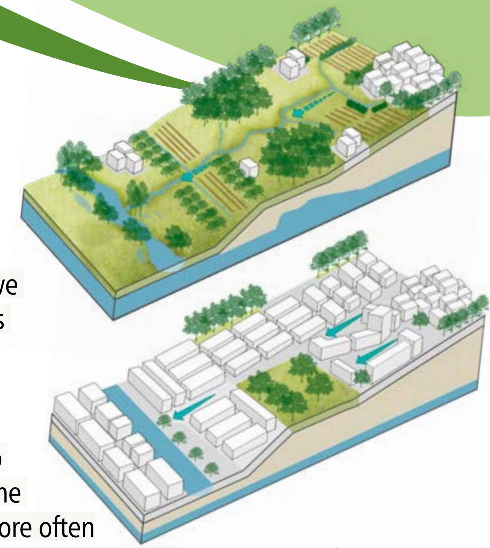
Today the Aniene is instead "humiliated" with illegal discharges of pollutants. It is feared in the rainy seasons and seldom considered as an ecosystem capable of self-regeneration. It would be enough to restore some simple situations that have been altered, allowing the river and the riparian system "to act as a river", operating as a natural purification system and habitat regeneration system, as well as a compensating lung, of extraordinary importance for urbanized areas. In addition to this potential we must add that of a potential nature reserve, an urban park that can improve the quality of life and the health of its inhabitants, also thanks to the pedestrian and cycling connections and the possible leisure activities it can offer.

Following a workshop carried out in 2016 by the Lazio Section of AIAPP in the Third Municipality of Rome, the main issues and potentials of the places crossed by the Aniene river where highlighted. Some design projects were drawn up (as planned in the project financed by the Lazio region) indicating how to resolve these issues, providing technical guidance and proposing applicable interventions in the territory examined, interventions that could also be applicable in different regional situations. The project data sheets report an assessment of the results that can be obtained in terms of micro-climate improvement, water absorption and purification, and urban landscape improvement.

Maria Cristina Tullio
(AIAPP Board of Directors)

BETWEEN TOO MUCH AND TOO LITTLE

We may not agree on the causes but we cannot ignore the facts: something is happening to the climate, even at our latitude. It is no longer necessary to read the statistics or listen to the opinion of eminent scientists to realize this. It is enough to read into the heart of each and every person and to feel the uneasiness, the anxiety with which more and more often we scrutinize the sky, asking how hot it will be and for how long, or how much water will that black cloud on the horizon bring...



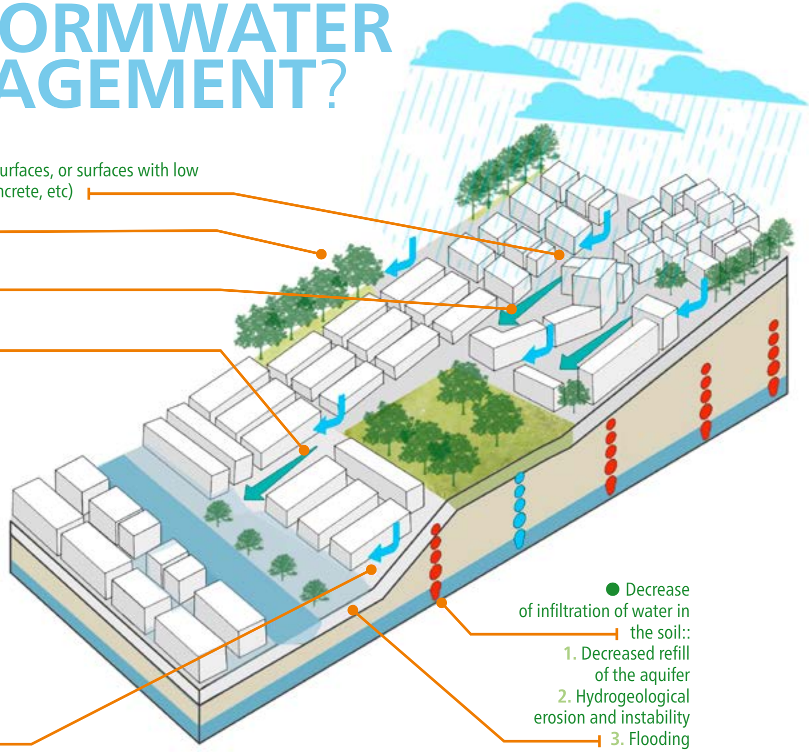
In a not so distant past, the urban environment still contained elements able to adapt to climate variables. Today this is no longer the case. It is not possible to go backwards, but we can and we must find new balances.

Extreme phenomena such as heat bubbles, prolonged periods of drought and flash floods with their potentially destructive effects are becoming a new form of "normality", a normality that our cities, now gone too far from what nature had arranged, are not able to absorb and manage any longer.
And there is something that is yet not understood by everyone...

Two sides of the same phenomenon

Shortage and excess of water are two aspects of the same phenomenon, closely connected. The duration of drought periods and the increase of heavy precipitation both depend on the intensification of the hydro-geological cycle, altered by climate change. The effects of one worsen the effects of the other extreme, causing a chain reaction. For this reason, to manage them effectively, we need a coordinated *stormwater management* project which addresses them together, simultaneously.

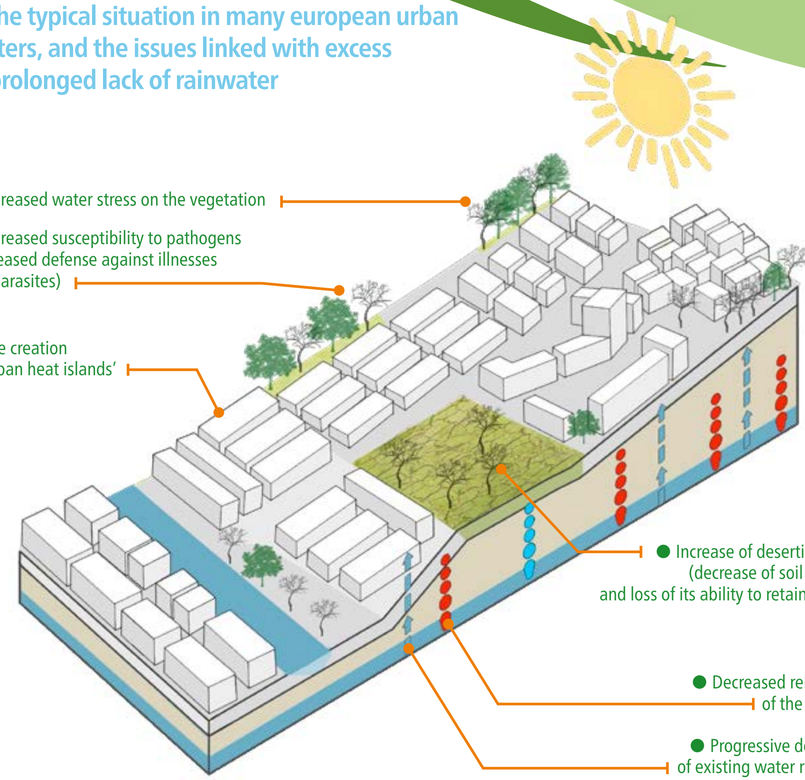
WHAT IS THE MEANING OF **STORMWATER MANAGEMENT**?



Elevated intensity of rainfall
(more than 30mm per sq mt per hour)

S*tormwater management*, literally the “management of meteoric waters”, is a part of overall water resources management.
The term refers to the management of rainwater, whatever its amount, from collection to disposal.
Drinking water management is yet another aspect, which is not taken into account here.
The management of stormwater presents different challenges in an extra-urban/agricultural environment than in an urban environment. In this booklet we are going to talk only of *stormwater management* in the urban environment.

The images in these pages show the typical situation in many european urban centers, and the issues linked with excess or prolonged lack of rainwater



Longer periods of drought

A *stormwater management* system effectively reduces the costs of managing traditional networks and above all the costs of the consequences of extreme weather events. Additionally it provides the tools needed to face more effectively the whole range of water conditions: from scarcity to excess water, drought to floods, including the waters of first rain (up to 5mm) and second rain (over 5mm).

The objectives of stormwater management are...

- Reduction of run off (surface rain water flow).
- Water purification from pollutants and its recovery for other uses.

The ultimate goal is the improvement of global quality of life in the city and the creation of a more efficient, adaptable urban system, even in the presence of extreme weather events.

RUN OFF
WHEN WATER RUNS...

The media too often remind us of the fact that our cities, as they are conceived today, are mostly unprepared for extreme weather phenomena.

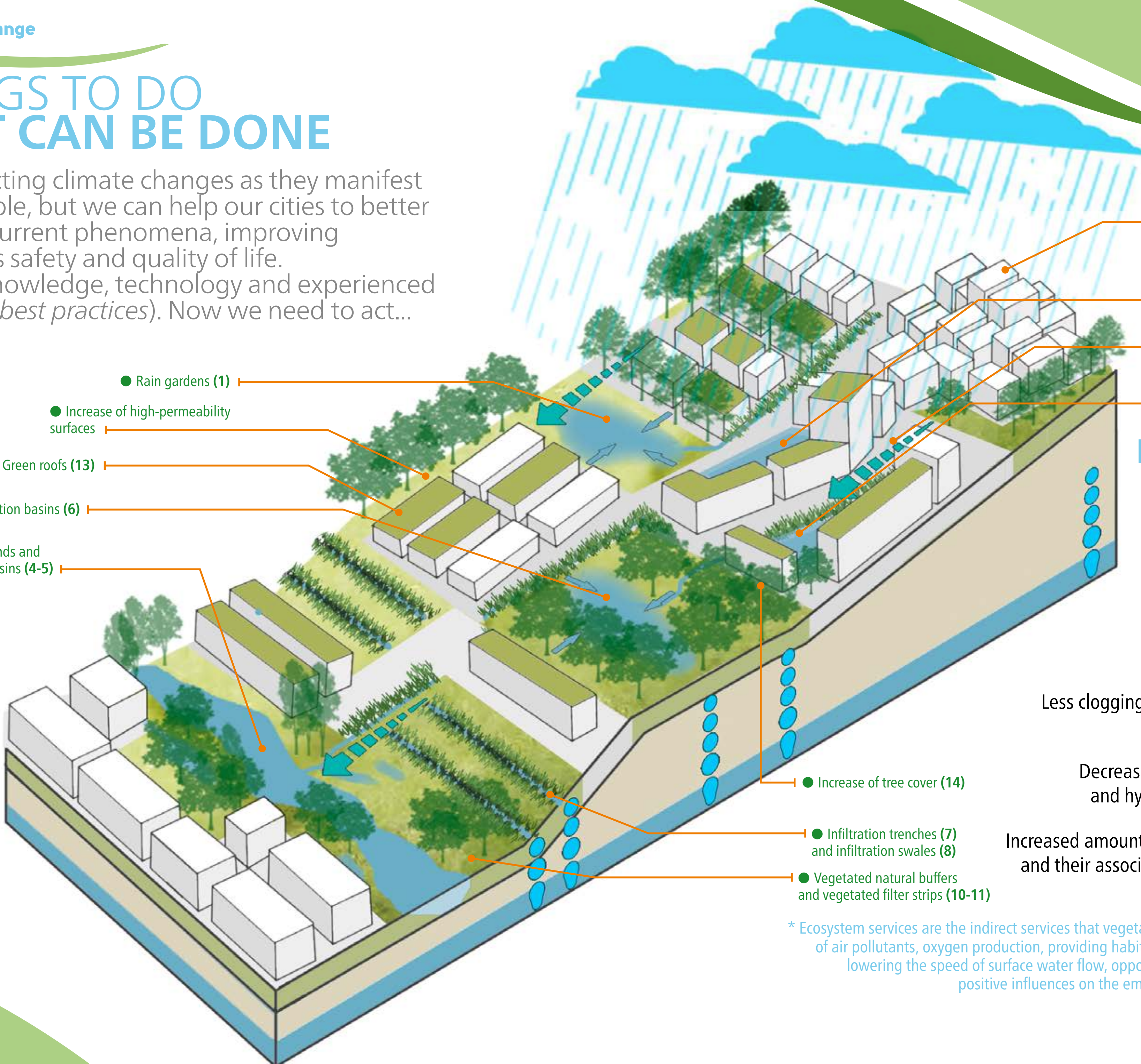
Absorption of excess rainwater clashes with the presence of extensive impermeable surfaces, roads and buildings that prevent water from entering the ground and increase quantity and speed, and therefore the destructive potential, of flowing waters. At the same time, a low percentage of green areas translates into failure to absorb rainwater, lack of a filtering effect and failure at refilling the aquifer.

Water collection systems are often inefficient and undersized compared to the current needs. Additionally, wastewater and gray water are not separated, impeding the correct purification of water. This helps to fuel the paradox for which an excess of rain does not translate into greater availability of reusable water for human use.
In fact, excessive rainfall becomes an instrument of collection and concentration of pollutants, for example residues of fuel oils and fine dust deposited by traffic on the roads, which floods collect and carry to the sea, to rivers and to the surrounding lands.

All this can be addressed and overcome, making our cities more livable, adaptable and safe...

THINGS TO DO
THAT CAN BE DONE

Counteracting climate changes as they manifest is impossible, but we can help our cities to better adapt to current phenomena, improving everyone's safety and quality of life.
There is knowledge, technology and experienced planning (*best practices*). Now we need to act...



IMMEDIATE EFFECTS

- Decrease in quantity and speed of water flow
- Less clogging of traditional rainwater management systems
- Decrease of erosion phenomena and hydrogeological instability
- Increased amount of green infrastructures and their associated *ecosystem services**

* Ecosystem services are the indirect services that vegetation provides, such as: purification of air pollutants, oxygen production, providing habitat for birds, insects and mammals, lowering the speed of surface water flow, opportunities for play and socialization, positive influences on the emotional state of the population etc.

More info > **turn page**

SOLUTIONS TO CONTAIN **SITUATIONS OF EXCESS OF WATER**

1 Rain gardens

Vegetated filtration systems are effective for treating rainwater coming from the roofs. The construction technique is similar to that of a sub-surface phytodepuration system.
Construction features: a waterproofed basin and a filtering medium with layers of different grain size such as gravel and sand on which suitable ornamental marshland or xeric plants are planted.
Functions: filtration and purification of water from roofs.
Association: storage tanks for storage and reuse of purified water.

2 Dry detention or overflow basins

These are basins designed to temporarily contain rainwater and release it slowly, so that within 24/48 hours they are completely emptied and remain dry.
The objectives of such basins are to control the quantity of rain water by reducing those flood peaks caused by extreme rains as well as to allow for partial sedimentation.
Construction features: either an embankment or dug directly into the ground.
Functions: run off management and sedimentation of particulate polluting substances.
Association: retention basins, primary sedimentation ponds and drainage trenches.

3 Extended detention basins

These basins are specially designed to store a certain amount of rainwater and slowly return it to the soil retaining some water permanently.
They are able to reduce the load of pollutants by encouraging the sedimentation of suspended solids.
Construction features: partially waterproofed basins.
Function: run off flow management as well as the sedimentation of particulates and suspended solids.
Associations: retention basins, ponds of primary sedimentation & drainage trenches.

System of basins and ponds, La Marjal floodable park, Alicante, Spain, 2015.
(Architects and engineers of the Municipality of Alicante).

4 Wet ponds (permanent ponds)

These are permanently flooded basins with a variable water level, in order to accommodate for rainwaters.
The size of the basin varies accordingly to the required pollutant retention capacity, planning where necessary for a wet area within the basin itself.
Flow control takes place by controlling the height of the level of the basins with exhaust systems.
Construction features: fully waterproofed basins.
Functions: run off flow management, tertiary treatment and removal of pollutants.
Association: retention basins, phytodepuration for secondary treatments, primary sedimentation ponds.

5 Sedimentation basins

These are basins with variable depths (1,2mt to 2,5mt) whose function is reducing flow and speed of inlet water to phytodepuration systems, as well as encouraging a preliminary sedimentation of suspended solids.
In a second stage the flow is introduced through these basins into the consequent wet area.
Every 5-10 years these basins must be cleaned from sediment that collects on the bottom.
Construction features: deep basins with anti-erosion banks.
Functions: inflow speed management and suspended solids sedimentation.
Association: phytodepuration systems, holding and retaining gray waters.

6 Infiltration basins

These are "off-line" systems designed to temporarily contain discrete volumes of rain water and to infiltrate it into the aquifer within a few days. These basins can be covered in vegetation useful for retaining pollutants and promoting soil permeability.
The main purpose is that of moving water flow from the surface to underground and to remove pollutants through mechanisms related to filtration, absorption and biological conversion as the water is moving through the soil.
Construction features: non-waterproofed water basin filled at the bottom with filling gravel of different grain size.
Functions: rain water depuration and infiltration.
Association: infiltration trenches.

Dry detention basin with marshland plants in autumn, floodable park in Mattuglie, Venice, Italy, 2012.
(CZstudio Associati: Paolo Ceccon, Laura Zampieri, Venice, Italy – photo: Laura Zampieri).

System of infiltration trenches, urban trekking path Monte Mario, Rome, Italy, 2016.
(Simone Amantia Scuderi, Rome, Italy – photo Simone Amantia Scuderi).

7 Infiltration trenches

These are drainage trenches with the function of intercepting rain water, partially infiltrating it into the soil and conveying it to other retention or treatment systems.
These solutions can reduce influx peaks and at the same time remove fine and soluble particulates through the storage and infiltration processes.
Construction features: a trench filled with gravel or stones, separated from the ground by a filtering geotextile and equipped with drainage tubes at its bottom.
Functions: rain water depuration and infiltration.
Association: infiltration basins, dry wells or retention and storage basins.

Rain gardens **(1)**, infiltration trenches **(7)** and infiltration swales **(8)**, are equally efficient in situations of excess and lack of water.

8 Infiltration swales

These are open linear trenches, with a grassy surface or with aggregate materials with an underlying layer consisting of a bed of gravel and a drainage pipe to convey the water. The water that flows on the surface slows down its speed, infiltrates in the underlying layer, with a simultaneous filtration and purification process, and is finally conveyed through the draining pipes. They are generally used for water coming from parking lots and roads.
Construction features: the surface of the canal is covered with an anti-erosion mat, below is a layer of sandy soil, possibly a separation layer made of a filtering geotextile, a layer of gravel and a pipe.
Functions: filtration, purification, rain water infiltration.
Association: infiltration basins, dry wells or retention and storage basins.

Infiltration swale, under construction, Roque Fraïsse Ecodistrict, Montpellier, France, 2016.
(Les Ateliers UP+, Christian Matteau Landscape Architect, Montpellier).

9 Dry wells

These are pits whose main purpose is to collect rain water and concentrate it.
Generally they are used for the water coming from roofs, draining trenches and parking lots' drainage water.
Construction features: the walls are made of concrete rings filled with gravel or stones, separated from the ground by a filtering geotextile.
Functions: rain water infiltration.

Infiltration swale, Roque Fraïsse Ecodistrict, Montpellier, France, 2016.
(Les Ateliers UP+, Christian Matteau Landscape Architect, Montpellier).

Association: infiltration basins, dry wells or retention and storage basins.

10 Vegetated natural buffers

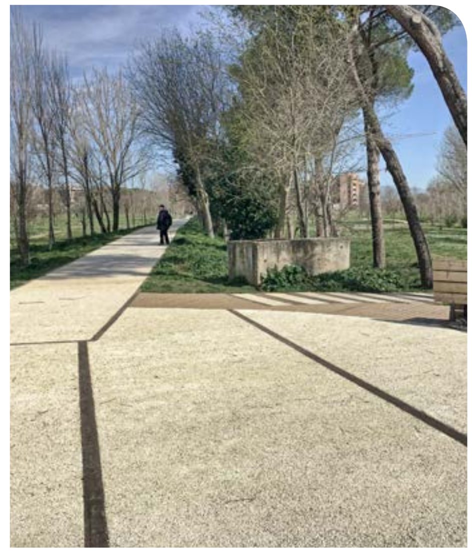
These are areas located upstream of receptor canals, covered in shrubs and arboreal vegetation, with the function of improving the quality of flowing waters, reduce its speed and favor its infiltration into the ground.
Construction features: strips of vegetation consisting of shrubs and trees.
Functions: deposition of pollutants, reduction of water flow velocity, partial purification and infiltration.
Association: vegetated filter strips.

11 Vegetated filter strips

These are slightly steep areas of terrain, designed to convey flowing waters coming from adjacent urban areas and to distribute them in a gradual manner through areas of dense vegetation (trees, grasses or shrubs).
Construction features: areas of steep terrain with systems of gradual distribution embankments.
Functions: the removal of pollutants by means of sedimentation, soil infiltration and flow speed reduction.
Association: vegetated natural buffers.

12 Draining paving

These are made with high porosity materials, laid in place so as to favor water infiltration.
The filtering materials, used for draining paving, have a high porosity that allows for water to percolate and reach the underlying layers whilst also performing a partial function of retaining pollutants.
Construction features: continuous or modular paving made of a high porosity material.
Functions: run off water infiltration and reduction in flow speed.
Association: draining trenches and dry wells.



Draining paving, Talenti Park, Rome, Italy, 2018.
(Maria Cristina Tullio, Rome – photo Maria Cristina Tullio).

13 Green roofs

These are multi-layered structures covering flat or sloping roof surfaces.
The primary layers of a green roof consist of: the load-bearing element, a waterproof layer, a layer of protection against the growth of roots, an element of mechanical protection, a layer of water accumulation, a draining element, a filtering element, and finally the substrate and vegetation.
Green roofs are advantageous for stormwater regulation, reduction of a building's energy consumption, reduction of the 'heat island' effect and mitigation of air and sound pollution.
Construction features: a multi-layered system (complying to the UNI norm 11235).
Functions: stormwater regulation, reduction of building's energy consumption, and microclimate mitigation.
Association: dry wells and rainwater collection systems.

14 Greater arboreal and shrub coverage

The arboreal and shrubby component of green areas acts as a balancing element in the hydrological cycle, affecting both on the physical characteristics of soil (increase in porosity thanks to the activity of roots) and on the outflow time of the waters (interception of rainwater caused by the foliage and the natural materials surface coverage).
Construction features: trees and shrubs.
Functions: stormwater regulation.
Association: vegetated natural buffers and vegetated filter strips.

Cycle path made with permeable paving, Calusco, Bergamo, Italy.
(i.idro DRAIN by Italcementi S.p.A. – photo Italcementi).

DROUGHT WHEN WATER IS LACKING…

Droughts and flood phenomena are closely related to each other: the effects of one worsen the effects of the other and both are strengthened by city infrastructures that are no longer suitable for the current climate changes.

Extensive urban waterproof surfaces prevent the infiltration of water into the soil and lead to a progressive decrease of soil water reserves.

In addition, less water in general and the current single existing water network, providing water both for drinking and irrigation, means that, in case of a drought, drinking water usage is prioritized, leaving public and private green spaces neglected.

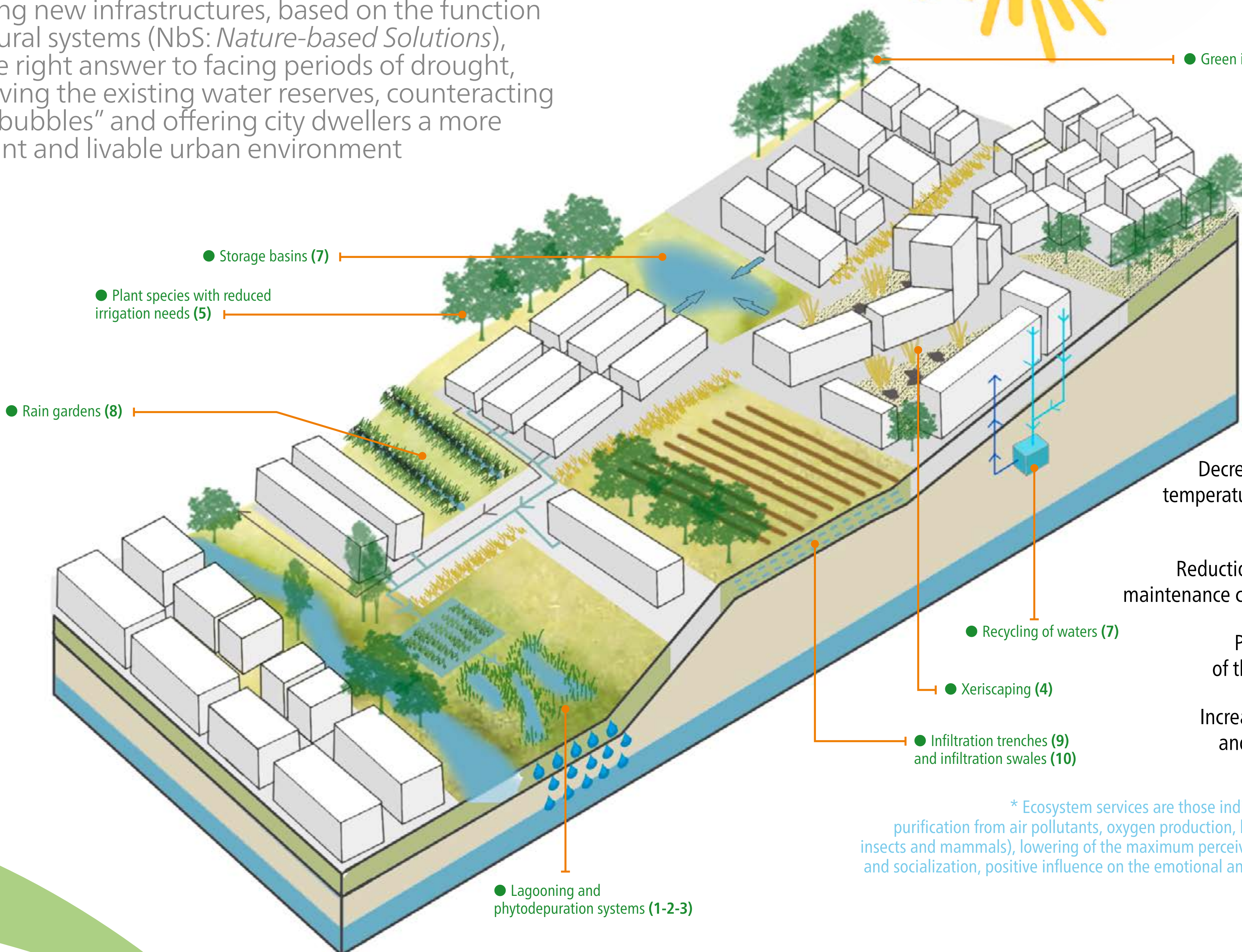
A lack of irrigation and the contemporary increase in temperatures means a loss of the most demanding vegetation types as well as the suffering of all urban green spaces, which thus become more fragile and prone to disease.

The progressive loss of green space in the city is a clear sign of this, immediately affecting the perceived heat levels, as well as decreasing air quality.

Less green spaces also means less possibilities to recover and filter rain water, with the consequent additional impoverishment of the available aquifers. It is possible to intervene immediately even on these difficult issues, improving everyone's quality of life…

THINGS TO DO **THAT CAN BE DONE**

Creating new infrastructures, based on the function of natural systems (NbS: *Nature-based Solutions*), are the right answer to facing periods of drought, preserving the existing water reserves, counteracting "heat bubbles" and offering city dwellers a more pleasant and livable urban environment



IMMEDIATE EFFECTS

- Decrease of maximum perceived temperatures and increased livability even during heat waves
- Reduction of the management and maintenance costs of green public spaces
- Protection and conservation of the existing water resources
- Increase in green infrastructures and their ecosystem services*

* Ecosystem services are those indirect services that vegetation provides: purification from air pollutants, oxygen production, biodiversity increase (habitat for birds, insects and mammals), lowering of the maximum perceived temperatures, opportunity for play and socialization, positive influence on the emotional and mental health of the population etc.

More info > **turn page**

SOLUTIONS TO CONTRAST **WATER SCARCITY**

Pond with constructed wetland and lagooning, Herzliya Park, Herzliya, Israel, 2014.
(Shlomo Aronson Architects, Jerusalem – photo Barbara Aronson).

1 Submerged flow phytodepuration systems

These are vertical or horizontal submerged waterproofed flow canals or basins, filled with gravel or crushed stone, equipped with a grey or black water collection and distribution system. The intense biological activity inside of the system removes a considerable amount of nutrients. These systems are used as a tertiary or final settling step, downstream of a secondary treatment system.

Construction features: waterproofed canal or basin filled with inert material and covered with marshland plants.
Function: purification of waste and rain water.
Association: primary sedimentation basins, secondary, tertiary and finalizing treatments.

Water channels with surface flow constructed wetlands, Herzliya Park, Herzliya, Israel, 2014.
(Shlomo Aronson Architects, Jerusalem – photo Barbara Aronson).

2 Surface flow phytodepuration systems (constructed wetland)

This system includes within the reservoir the presence of riparian areas. It improves the quality of the waste water and of the waters that have already undergone a primary or secondary treatment.

Construction features: waterproofed basins with floating plants and bank areas filled with gravel and planted with marshland plants.
Function: tertiary purification of waste and rain water.
Association: storage tanks for reuse of purified water.

3 Lagooning

Lagoons (or oxidation ponds) are basins of a high hydraulic and biological retention time, and with powerful removal effects of pollutants, especially bacteria.
Moreover, they have the function of compensating for peaks of hydraulic and organic loads.
The bottom is waterproofed to avoid percolation into the aquifer.

Construction features: waterproofed basin.
Function: the management of hydraulic loads and tertiary treatments.
Association: primary sedimentation basins, secondary, tertiary and finalizing treatment systems.

4 Xeriscaping

This is a systematic approach to landscape design aimed at the conservation of irrigation water. It combines seven basic principles: planning and designing, improvement and the amendment of soil, efficient irrigation, zoning of plants (grouped according to the plants' water and exposure needs), organic or inorganic mulching, minimizing use of turf and a specific maintenance plan.

Construction features: drought-resistant plants, materials and techniques with low irrigation consumption.
Function: low irrigation needs, low maintenance.
Association: stormwater recovery systems.

5 Choice of low irrigation species

The choice of plants is fundamental to designing a landscape with low water consumption. Amongst drought resistant plants let's remember those belonging to the Mediterranean climate as well as those belonging to cold dry climates, and succulents.
In order to have optimal resistance, choosing the right plants must go alongside with suitable planting, crop care and site preparation techniques.

Construction features: choice of plants that are resistant to arid weather and correct planting techniques.
Function: low irrigation water consumption.
Association: xeriscaping and stormwater recovery systems.

Xeriscaping, Mediterranean Garden of Stavros Niarchos Foundation Cultural Center, Athens, Greece, 2016.
(RPBW, Genoa, landscape architect Deborah Nevins & Ass., New York – photo Gabriele Rasconi).

Low irrigation species, Mediterranean Garden of Stavros Niarchos Foundation Cultural Center, Athens, Greece, 2016.
(RPBW, Genoa, landscape architect Deborah Nevins & Ass., New York – photo Gabriele Rasconi).

6 Efficient irrigation techniques and technologies

These include different technologies for different parts of an irrigation system: the use of sensors able to calculate the amount of useful water in the soil, small weather stations able to calculate evapotranspiration and the most efficient type of distribution such as sub-irrigation with adjacent dripping wings.
All these techniques combined will help to provide the exact amount of water needed for the plants, without wasting it.
Construction features: highly efficient irrigation systems.
Function: conservation of irrigation water.
Association: stormwater recovery and storage systems, xeriscaping, phytodepuration.

7 Stormwater recovery and storage systems

These must be designed following a careful hydrological calculation specific for that microclimatic area.
Generally, they include a sedimentation system that separates suspended solids and coarse material, one or more secondary treatment systems (depending on the origin of the waters), and a reservoir or a water storage basin.
Construction features: these are made up of different elements combined together.
Function: rain water purification and storage.
Association: rain gardens, infiltration trenches, phytodepuration systems, primary sedimentation ponds.

8 Rain gardens

Vegetated filtration systems are effective for treating rainwater coming from the roofs. The construction technique is similar to that of a sub-surface phytodepuration system.
Construction features: a waterproofed basin and a filtering medium with layers of different grain size such as gravel and sand on which suitable ornamental marshland or xeric plants are planted.
Function: filtration and purification of water from roofs.
Association: storage tanks for storage and reuse of purified water.

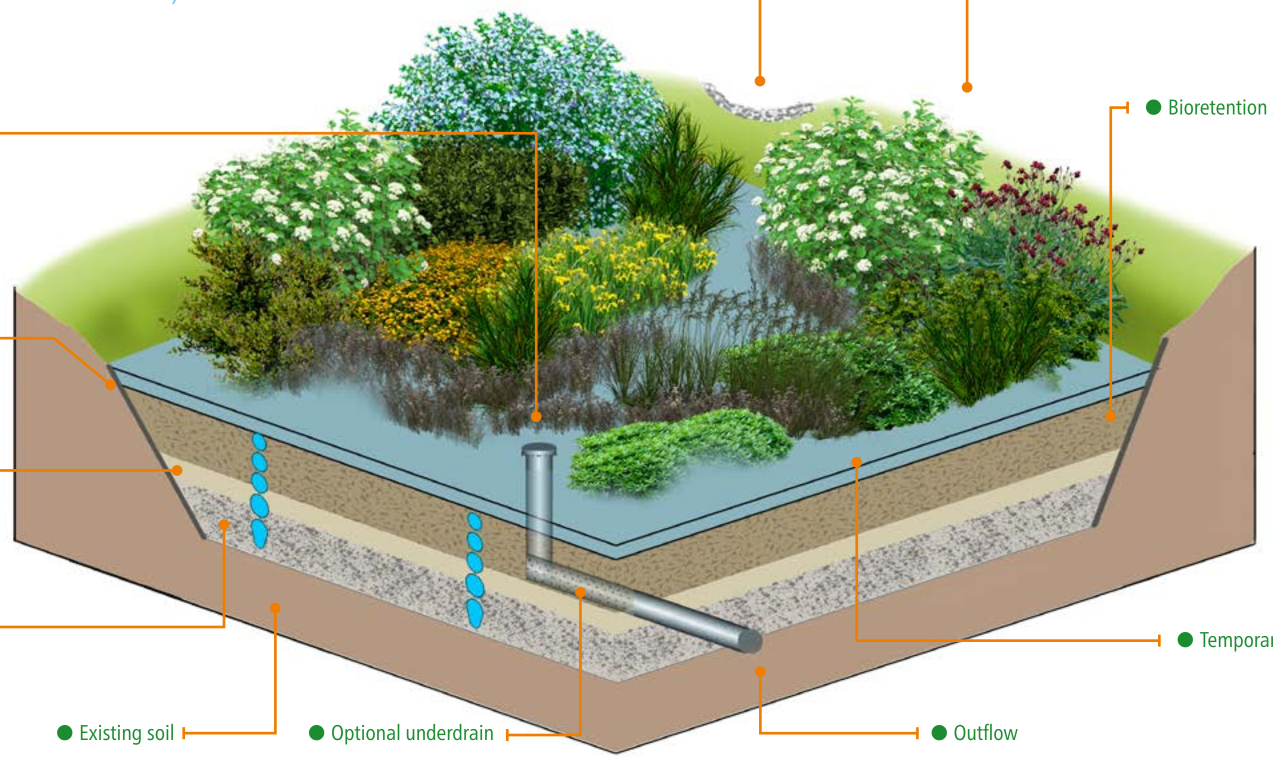
9 Infiltration trenches

These are drainage trenches with the function of intercepting rain water, partially infiltrating it into the soil and conveying it to other retention or treatment systems.
These solutions can reduce influx peaks and at the same time remove fine and soluble particulates through the storage and infiltration processes.
Construction features: a trench filled with gravel or stones, separated from the ground by a filtering geotextile and equipped with drainage pipes at its bottom.
Function: rain water depuration and infiltration.
Association: infiltration basins, dry wells or retention and storage basins.

10 Infiltration swales

These are open linear trenches, with a grassy surface or with aggregate materials with an underlying layer consisting of a bed of gravel and a drainage pipe to convey the water. The water that flows on the surface slows down its speed, infiltrates in the underlying layer, with a simultaneous filtration and purification process, and is finally conveyed through the draining pipes. They are generally used for water coming from parking lots and roads.
Construction features: the surface of the canal is covered with an anti-erosion mat, below is a layer of sandy soil, possibly a separation layer made of a filtering geotextile, a layer of gravel and a pipe.
Function: filtration, purification, rain water infiltration.
Association: infiltration basins, dry wells or retention and storage basins.

RAIN GARDEN (CONSTRUCTION SCHEME)



Rain gardens **(8)**, infiltration trenches **(9)** and infiltration swales **(10)**, are equally efficient in situations of excess and lack of water.

SAME COSTS, MORE VALUE

Costs and benefits of *Nature-based Solutions* (NbS), technical solutions based on natural models

Floods in densely populated areas put citizens' lives at risk and cause damage to infrastructure and production in excess of several million euros. Therefore, changing the approach to using solutions based on natural systems is not only necessary but also extremely convenient

Plants are by their nature multi-functional; they do not perform a single task at a time, the whole range of their benefits elevates quality of life for us humans. Depending on the type of greenery, however, some benefits (also called *ecosystem* services) may be prevalent over others. In recent decades, in fact, technological systems based on the characteristics of different plant species have been developed to respond to specific problems. These are the so-called **Nature-based Solutions (NbS)**, "solutions based on natural models", defined by the International Union for Conservation of Nature (IUCN) as "*actions to sustainably protect, manage and regenerate natural or modified ecosystems, addressing social challenges effectively and adaptively, while providing benefits for biodiversity and human well-being".*
Among the most interesting Nature-based Solutions are the stormwater management and regulation systems in the city (we talked about it in the previous pages), designed for the treatment of rainwater but manifesting positive effects also in other areas, such as biodiversity conservation, landscape quality and the general health of a place.

Higher and higher costs

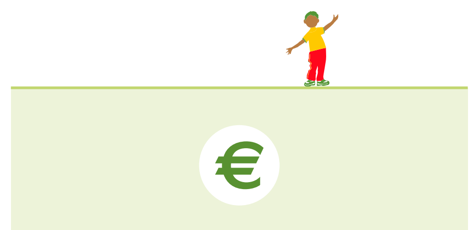
Where there is no more draining soil and the ground has been made waterproof (with roads, pavements, buildings etc.) there is a problem of rainwater disposal. Floods are often due to the artificialisation of waterways and the waterproofing of soils through a process that has grown over the years and that has led to continuous emergencies and frequent calamities. The gradual disappearance of the natural rain disposal systems has caused very expensive interventions to have had to take place. These include the construction and maintenance of ever larger and more complex hydraulic infrastructures in order to contain ever-increasing flows of water.

A new approach

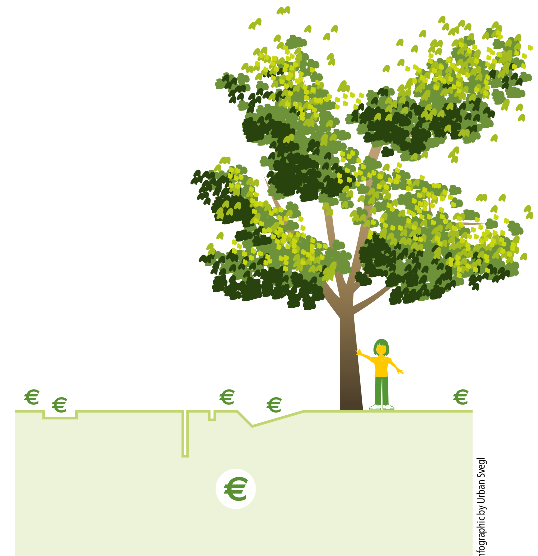
A growing number of major cities around the world have decided to tackle the problem differently, trying to prevent these events, limiting the waterproofing of soils and designing green structures that can help the natural outflow of rains. These include *rain gardens* and *bio-swales*, which are considered essential tools for good stormwater management in the urban environment. These are green installations based on the same principle: to create a light depression in the soil with a draining layer where mostly native (indigenous) species are planted, able to withstand both flooding and prolonged drought. While *rain gardens* are small green areas within public gardens or private gardens and estates placed near collection wells, *bioswales* are larger and are located near sources of rainwater flow, such as driveways, cycle paths, parking lots and paved surfaces. They can appear as strips of lawn at the side of the streets or as small gardens with trees and shrubs. *Tree boxes* can also represent an application of the same concepts. They are concrete boxes to house a tree, filled according to a precise stratigraphy and with a suitable substrate, which collects, filters and conveys the stormwater coming from sidewalks or nearby streets. All these types of systems additionally offer an important function of purification from heavy metals, particulates, residue substances and polluting organic substances that are filtered by plants and soil. But how much do these solutions cost and how convenient are they?

Total Economic Value

Estimates have been made for the assessment of the benefits provided by NbS. In order to be able to give a reliable estimate of the ecosystem services provided (support, regulation, procurement and socio-cultural) the relative *Total Economic Value* (VET)[1] was calculated. Each square meter of this type of greenery is potentially able to save from a minimum of **0.50** to a maximum of **14.92 euros/m2/year**, whilst the construction and management costs are easily assimilated within the costs of realizing semi-intensive or extensive green spaces, such as neighborhood gardens and nature parks. The main component of VET for these types of green spaces, estimated in this way, is the regulatory service, divided into almost equal parts between the functions of control of water and the absorption of CO_2.
In other words, solutions based on natural models do not cost more than any other type of well-crafted public greenery. But they also provide ecological and environmental benefits, able to manage if not prevent the damage caused by extreme weather events, with a significant reduction in the costs of construction and management of artifacts (sewage, pipelines, wells, tubs etc.).



Old paradigm
All the interventions and funding available are assigned to underground infrastructure; the soil is sealed, and we try to make the flow of water to the drainage systems as fast as possible.



Infographic by Urban Svegl

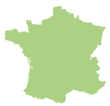
New paradigm
At the same costs funding also includes surface structures, which can embellish the urban fabric and are designed to collect and filter stormwater and to slow down their flow to drainage systems.

1. Francesca Neonato, Francesco Tomasinelli, Barbara Colaninno, 2019. *Oro verde. Quanto vale la natura in città*. Il Verde Editoriale Milano.

Links to

BEST PRACTICES

A short list, incomplete but exemplary, of best practices and design solutions already implemented in Italy and Europe



France:
Les Ateliers UP+ , Christian Matteau landscape architect, Roque-fraisse éco-quartier, Montpellier
- https://ateliersup-plus.fr/fr/roque-fraisse-un-eco-quartier-mediterraneen

Agence Ter, Henri Bava, Michel Hössler, Olivier Philippe, Gran Parc des Docks, Saint-Ouen, Paris
- http://www.saint-ouen.fr/services-infos-pratiques/environnement-et-espaces-verts/118-le-grand-parc.html

D'Icy Là paysage et territoires, Sylvanie Grée, Claire Trappenard, Parc Bougainville, Marseille (project 2017-2019)
- https://www.euromediterranee.fr/projets/parc-bougainville

Greece:
Renzo Piano Building Workshop (RPBW), Stavros Niarchos Park, Athens, 2008-2016
- http://www.rpbw.com
- https://www.floornature.it/rpbw-centro-culturale-fondazione-stavros-niarchos-kallithea-12060/#
- http://www.dnalandscape.com/about.html

Israel:
Shlomo Aronson Architects: Herzliya Park + Glil Yam Park, Herzliya Municipality, 2014
- https://www.s-aronson.co.il/portfolio-item/herzelia-park/
- https://www.s-aronson.co.il

The Commons, Tel Sheva Master Plan
https://www.nachalat.com/copy-of-project-tel-sheva

Rachelle Wiener Landscape & Architecture, Gazelle Valley Park, Jerusalem, 2013-2015
- https://www.gazelle-valley.com
- http://www.jerusalemfoundation.org/heritage/gazelle-valley.aspx

Italy:
Maria CristinaTullio, paesaggiepaesaggi, Parco Talenti, Rome, 2018
- http://www.paesaggiepaesaggi.it

CZstudio Associati: Paolo Ceccon, Laura Zampieri, floodable park in Mattuglie, Venice, 2012
- http://czstudio.com/studio

Spain:
La Marjal Park, Alicante
- https://www.alicante.es/es/equipamientos/parque-marjal

IFLA EUROPE
Med_net Working Group
INTERNATIONAL FEDERATION OF LANDSCAPE ARCHITECTS

IFLA Europe Med_net working group

In 2017 a network was formed, the *IFLA Europe Med_net* working group, that brings together countries bordering the Mediterranean or that share its climatic and environmental characteristics. The group is made up of delegates from all the Mediterranean countries that are members of IFLA Europe (*International Federation of Landscape Architects*): Croatia, France, Greece, Israel, Portugal, Slovenia, Spain and Turkey, with Italy as coordinator. The mission of IFLA is to promote landscape architecture in institutional issues and policies at every level, local, national and global, to establish quality standards for landscape projects and for professional landscape education and to facilitate the exchange of knowledges and experiences between the members. AIAPP (*Associazione Italiana di Architettura del Paesaggio*) is the only Association that represents Italy through the role of the IFLA delegate.

The aim of the *IFLA Europe Med_net working group* is to optimize the work of landscape architects on similar issues by concentrating their efforts, increasing awareness and ensuring a more efficient communication, while saving energy and resources.
The common challenges to be faced – obviously from the landscape architect's point of view – touch on many aspects of life in Mediterranean countries.

During the first meeting of the group in June 2018 we have developed a (open) list of possible topics of interest to all Mediterranean countries, divided into five macro-areas: environment, climate, social, culture, policies. From this list specific themes will be formulated to be dealt with in depth with research on innovative techniques and technologies, design solutions (best practices) and regulations or laws that make it possible to operate optimally in the individual countries.
All results of our work will be shared with the member countries of the *IFLA Europe Med_net working group*.

Each year the group chooses a main theme on which to concentrate research and communication for a certain period. For 2019/2020 the theme is: *stormwater management*.

Uta Zorzi Mühlmann
IFLA delegate and IFLA Europe Med_net working group coordinator

This booklet was made
with a contribution
of the Lazio Region pursuant
to the Regional Regulations
n. 19 of 17 July 2018.
Notice of the Determination
n. G13950 of 05/11/2018,
n. 17852 of 10/31/2018
(Period: February 1 – May 31, 2019).

ROMA
Municipio Roma III

Italcementi HEIDELBERGCEMENT Group

RAIN BIRD.

vivai rasconi

IFLA EUROPE
Med_net Working Group
INTERNATIONAL FEDERATION OF LANDSCAPE ARCHITECTS

Biennale
Spazio
Pubblico

BluMedia

IX EU FESTIVAL 2019
VIE FRANCIGENE
CAMMINI WAYS CHEMINS