



**URBAN GreenUP** 

# **D2.2** Baseline document to Valladolid

WP 2, T 2.2

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# 0 Executive summary

The **Baseline to Valladolid** is the first measurement of all the key performance indicators (KPIs) contemplated in the URBAN GreenUP project for Valladolid Demo-Site. It allows knowing the indicators value before the planned actions execution and the comparison of the same indicators after the execution of the actions. Therefore, Baseline establishes the starting point of the Project and for every intervention.

Baseline definition begins with a regulations analysis, as well as the challenges and limitations for every Nature Based Solutions (NBS) group.

#### Regulations

Regulations at European, national, regional and local levels have been identified for every NBS Group. The following is an abstract of main regulations.

Vegetation, parks and gardens	<ul> <li>RD 1628/2011, List and Spanish Catalogue of exotic and invasive species.</li> <li>Royal Decree 630/2013, Spanish Catalogue of invasive alien species.</li> <li>Royal Decree 139/2011, List of Wild species in special protection regime and the Spanish Catalogue of threatened species.</li> <li>Royal Decree 1311/2012, on Sustainable use of plant protection products.</li> <li>Regulation for Parks and gardens in Valladolid (March 1990).</li> </ul>
Water and flood risk	<ul> <li>Water Framework Directive (Directive 2000/60/EC).</li> <li>Urban Wastewater Treatment Directive (Directive 91/271/EEC).</li> <li>Directive 2007/60/EC on the Assessment and management of flood risks.</li> <li>Water Law Consolidated Text (Legislative Royal Decree 1/2001).</li> <li>Regulation of the Public Hydraulic Domain which develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text.</li> <li>Hydrological Plan of the Duero river basin district (Royal Decree 907/2007).</li> <li>Royal Decree Law 11/1995, for Urban Wastewater treatment.</li> <li>Royal Decree 1620/2007 on Regulations for Water reuse.</li> <li>Royal Decree 903/2010 on Evaluation and management of floods risks.</li> <li>Civil Protection Plan for Flood risk in Castilla y León (INUNcyl) (March 2010).</li> <li>Flood Risk Management Plan of the Duero's basin (Royal Decree 18/2016).</li> <li>Regulation for Water supply and sanitation in Valladolid (April 2006).</li> </ul>
Urban planning and mobility	<ul> <li>General Urban Planning Plan of Valladolid 2012 (PGOUVa 2012); updating (2017).</li> <li>Historic Quarter Special Plan, (PGOUVa 2004).</li> <li>Technical Building Codes CTE-DB-SI, CTE-DB-SE, CTE-DB-HS.</li> <li>Regulatory Ordinance of Bicycle Mobility in Valladolid municipality (March 2015).</li> <li>Comprehensive Urban, Sustainable and Safe Mobility Plan for the city of Valladolid (PIMUSSVA). Sectoral Programs: Empowering non-motorized modes (Cyclist and pedestrian). Land management and parking (November 2015).</li> </ul>
Air quality	<ul> <li>Regulation for Atmospheric environment protection (July 1997).</li> <li>Action Plan for Pollution Alert (April 2017).</li> </ul>
Noise	<ul> <li>Law 37/2003 on Noise.</li> <li>Law 5/2009 on Noise in Castilla y León.</li> <li>Ordinance on Noise in Valladolid (May 2013).</li> </ul>



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	<ul> <li>Municipal Plan against Noise Pollution of Valladolid (2008).</li> </ul>
Public management	<ul> <li>Royal Decree 1372/1986 on the Regulation of goods of local entities.</li> <li>Regular Fiscal Ordinance of Taxes for private or special use of the Municipal Public Space in Valladolid.</li> </ul>
Non- technical actions	<ul> <li>Environmental Education Strategy in Castilla y León (2003).</li> <li>Municipal Environmental Education Program (Local Agenda 21).</li> <li>Law 37/2007 on the Re-use of information from the public sector (mod. Law 18/2015).</li> <li>Law 10/2012 on Transportance access to public information and good</li> </ul>
	• Law 19/2013 on Transparency, access to public information and good governance.
	• Ordinance on Transparency, access to information and its reuse (Sep. 2016)
	• Decree 2369 on Bases for the ecological gardens proposals 2016-2017.

#### **Main challenges and Limitations**

The following is an abstract of main challenges and limitations identified.

Public management	<ul> <li>Slow periods for public tendering and processing may generate delays.</li> <li>Local regulations may not be adapted to the green solutions of the project.</li> <li>Valladolid City Council must define final locations whose process may also be slow.</li> <li>The need of maintenance even after project ending.</li> </ul>
Administrative	<ul> <li>Internal coordination among Valladolid City Council Areas.</li> <li>Lack of correspondence between the URBAN GreenUP project and political agenda.</li> </ul>
Technical	<ul> <li>Lack of available space for the intervention.</li> <li>Few companies with experience in the NBS implementation in Valladolid area.</li> </ul>
Economical	<ul> <li>Actions and activities not considered into the initial budget such as maintenance, previous studies for the Floodable park or grown trees higher cost.</li> <li>Non-technical actions have not been considered into the initial budget.</li> </ul>
Environmental	<ul> <li>Terms of use of vegetation, according to climatic conditions.</li> <li>Autochthonous, non-invasive and non-allergenic species selection.</li> </ul>
Social	<ul><li>Citizens do not know what is a NBS, which could lead to citizen rejection.</li><li>Vandalism.</li></ul>

#### **Indicators selected for every NBS**



For the city of Valladolid there have been initially selected 46 **key performance indicators (KPIs)**, which includes 29 core KPIs.

For every KPI and the EKPLISE Challenge which addresses, the type of indicator and measure unit are identified. KPI proposed unit shows an initial measure method identified for every NBS.

For every KPI, the currently available **data sources** for calculating the Baseline have been identified. It has also been identified the

data sources that do not currently exist but are planned to get within the URBAN GreenUP project. KPIs are grouped into technical, economic and social indicators.





The following tables show the KPIs selected for every EKLIPSE Challenge and every NBS Group that will demonstrate their impacts. The tables are the result of the NBS assignment work with their KPIs performed in this Baseline by the Work Package 2 partners.

#### **CHALLENGE 1: Climate mitigation & adaptation**

Туре	KPI Definition	KPI unit	NBS Group
Carbon savings; storage and sequestration	CO <sub>2</sub> eq emissions avoided considering a life cycle approach and modelling the environmental impacts regard to indirect savings.	(t CO₂eq ∕year	Green cycle lane
	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(t CO <sub>2</sub> /Ha) (t CO <sub>2</sub> /year) (t)	Tree related actions, SUDs, Natural Wastewater Treatment Plant, Rain gardens, Green filter area, Floodable park
Temperature reduction (environm-	Decrease in mean or peak daytime local temperatures (°C)	(°C)	Tree related actions, Green Parking Pavements, Vertical & Horizontal GI, Electro wetland
ental, Heatwave risks (number of combined tropical physical) nights (>20 °C) and hot days (>35 °C)		(nº days)	Tree related actions, Vertical & Horizontal green interventions
Other	Use of <i>Star tools</i> to calculate projected maximum surface temperature reduction (°C)	(°C)	Tree related actions, Green Parking Pavements

• Calculation: IPCC methodology, from the trees and brushes census in Valladolid.

• Temperature reduction data from Spanish State Meteorological Agency (AEMET) and the Valladolid City Council Air Pollution Control Network (RCCAVA).

#### **CHALLENGE 2: Water management**

Туре	KPI Definition	KPI unit	NBS Group
	Absorption capacity of green surfaces, bioretention structures and single trees	(m³/m²) (m³/tree)	Green cycle lane, NWTP, Green filter area, Floodable park, Smarts soils
Run-off coefficient in relation to precipitation     T       Physical     quantities		Tree related actions, SUDs, Rain gardens, Green parking pavements	
indicators	Temperature reduction in urban areas (°C, % of energy reduction for cooling)	eduction in urban areas (°C, % of (°C, % energy reduction)	Electro wetland
1	Areas (Ha) and population (inhab) exposed to flooding	(Ha) (inhab)	Tree related actions, Vertical green interventions, Floodable park
Chemical	Drinking water provision	(m³/Ha/year)	n/a
indicators (water quality)	Water for irrigations purposes	(m³/Ha/year)	Tree related actions, NWTP, Rain gardens, Green parking pavements, Horizontal green interventions
Economic	Volume of water removed from water treatment system	(€/m³)	n/a
(benefits)	Volume of water slowed down entering sewer system	(€/m³)	n/a

- Annual rainfall data from AEMET and RCCAVA.
- Runoff retention data obtained from literature.





CHALLINGE 4. OFCCH Space management
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Туре	KPI Definition	KPI unit	NBS Group
Social	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Green cycle lane, Tree related actions, SUDs, NWTP, Rain gardens, Green filter area, Vertical & Horizontal green interventions, , Floodable park, Electro wetland, Urban farming promotion, Educational activities
(benefits) Weighted recreation opportunities provided by urban green infrastructure. Distribution of public green space – t surface or per capita.	Weighted recreation opportunities provided by urban green infrastructure.	(nº)	Green cycle lane, Tree related actions, Educational activities
	Distribution of public green space – total surface or per capita.	(m²/capita) (km <sub>cycle lane</sub> /capita)	Green cycle lane, Tree related actions, Educational activities, NWTP, Vertical green interventions, Floodable park
	Production of food (ton/Ha/year)	(ton/Ha/year)	Horizontal green interventions
Environmental (biological)	Increased connectivity to existing GI	(m) (%)	Green cycle lane, Tree related actions, Pollinators modules
	Pollinator species increase (number)	(nº) (%)	Vertical green interventions

# • Sustainability indicators of Local Agenda 21 of Valladolid, provided every two years such as Inhabitants living closer than 500 m of any green area.

- Increased connectivity and other territorial KPIs will be calculated with GIS analysis tools.
- Production of food is another KPI which will be calculated in urban orchards.

#### CHALLENGE 5: Air Quality

Туре	KPI Definition	KPI unit	NBS Group
	Air quality parameters NOx, VOC, PM: Units: (μg/m3) CO (mg/m3) O <sub>3</sub> (μg/m3) C <sub>6</sub> H <sub>6</sub> Quality air index (ICA)	(µg/m³) (ICA)	Green cycle lane
Environmental (chemical)		(µg/m³)	Tree related actions, Vertical & Horizontal green interventions, Green filter area
(enemical)	Trends in emissions NOX, SOX: (μg/m3) SO₂ (μg/m3) NO (μg/m3) NO₂	(µg/m³)	Natural Wastewater Treatment Plant, Smarts soils as substrate, Electro wetland
	Trends in emissions CO	(mg/m³)	Floodable park
Economic	Monetary values	(€)	n/a
Social (physiological)	Number of deaths from air, water and soil pollution and contamination.	(nº deaths)	n/a

• Concentration and trends in emissions of different pollutants from the RCCAVA. URBAN GreenUP project will also include a new sensors network for temperature and humidity.

#### **CHALLENGE 6: Urban Regeneration**

Туре		KPI Definition	KPI unit	NBS Group
Urban gr indicato	reen ors	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale)	(km <sub>road</sub> substitution by cycle <sub>lanes</sub> ) (nº	Green cycle lane, NWTP, Rain gardens, Green Parking Pavements,





(environmental,		species) (%	Electro wetland, Promotion of NBS at
biological)		satisfaction)	citizen scale
	Enhance biodiversity and community		
	engagement. Convert brownfield to	(m²)	Urban farming promotion
	green areas in urban regenerat. projects		
Socio-cultural	Savings in energy use due to improved	$(l_{1}) \wedge (l_{2})$	Vertical & Horizontal green
indicators	Green infrastructure	(KVVII/III)	interventions

• Install electricity meters to measure the expenses in air conditioning and heating.

#### **CHALLENGE 7: Participatory Planning and Governance**

Туре	KPI Definition	KPI unit	NBS Group
Social	Perceptions of citizens on urban nature: - Green spaces quality - Water for drinking quality - Air quality	(% satisfaction)	Tree related actions, SUDs, NWTP, Rain gardens, Green Parking Pavements, Electro wetland, Promotion of NBS at citizen scale

- Sustainability indicators of Local Agenda 21 of Valladolid, such as Green spaces quality, Water for drinking quality and Air quality.
- URBAN GreenUP mobile application to collect the citizens' opinions through surveys.

#### **CHALLENGE 8: Social Justice and Social Cohesion**

Туре	KPI Definition	KPI unit	NBS Group
Social cohesion	Green intelligence awareness	(nº educ. actions) (inhab attended)	NWTP, Electro wetland, Educational activities

• Data expected in URBAN GreenUP project.

## CHALLENGE 9: Public Health and Well-being

Туре	KPI Definition	KPI unit	NBS Group
Health indicators	Increase in walking and cycling in and around areas of interventions.	(users) (bicycles)	Green cycle lane, Tree related actions, Floodable park
Psychological indicators	Noise reduction rates: - (dB(A)) (exposed population to noise) (dB(A) /m <sup>2</sup> vegetation unit)	(dB(A))	Vertical green interventions

- URBAN GreenUP mobile application and data from Mobility Area statistics.
- Noise data will be obtained from Municipal Plan against Noise Pollution and RCCAVA.

## CHALLENGE 10: Potential of economic opportunities and green jobs

Туре	KPI Definition	KPI unit	NBS Group
Economic	Number of jobs created: Number of people who find a job and leave the urban orchard. Gross value added: Compost production (kg/year) (€/year)	(jobs) (kg <sub>compost</sub> /year) (€ <sub>saved</sub> /year)	Urban farming promotion

• Opening License Department from Valladolid City Council.





# 1 Introduction

In projects management context, is well known that a "baseline" is an established state by which something is measured or compared. It seems clear that in any project in which it is necessary to evaluate the impact of the actions / interventions that will be carried out, it is proper to know the starting situation (baseline) against which to evaluate the obtained results.

This deliverable reflects the work done in the definition of the group of main KPIs that will be used in the definition of the baseline and of the calculation methodologies that will be used to calculate it. In addition, the results of applying these methodologies to some of the actions foreseen in this previous phase are collected, which are expressed as available data or expected data, either provided in the URBAN GreenUP project or obtained from bibliography.

However, this deliverable shows the current state of the definition and calculation process of the baseline and of the demonstration project planned for Valladolid. Both the accurate definition of the indicators to be used and their use to define the current state of the locations (baseline) where the interventions are located will be completed in the forthcoming months.

This Baseline document also contains the Regulations for the actions development in Valladolid expressed for every action/intervention (Nature Based Solutions, NBS) or by groups of NBS; as well as the challenges and limits identified for each one.

The following paragraph describes Key Performance Indicators' (KPIs) selection process of the URBAN GreenUP project for Valladolid.

# **1.1** Key performance indicators (KPIs) of URBAN GreenUP

URBAN GreenUP project aims to create evidence about the NBSs impact in cities to fight climate change, improve wellbeing and build more sustainable livelihoods.

Each NBS generate several impacts; these may be evaluated through a set of indicators by using specific types of methods (KPIs, Key Performance Indicators). An objective method to evaluate the actions, impacts and performance is necessary. WP1, WP5 and WP7 are defining those indicators for URBAN GreenUP. Their measurement methods are still in defining process.

URBAN GreenUP will adopt several KPIs for the evaluation of NBSs impacts in front-runner cities. The EKLIPSE framework is being used as starting point to elaborate a homogeneous framework for the evaluation of NBS and to compare results through cities. Other KPIs are being adopted in order to frame the project evaluation not just in the European context but also in an international one.

This framework is taking into consideration all NBS impacts at different scales. Other initiatives that have been included are: European Green Capital Award, Sustainable Development Goals (SDGs), Convention on Biological Diversity - Aichi targets, The Economics of Ecosystem Services (TEEB) and Mapping and Assessment of Ecosystem Services (MAES).





# 1.1.1 EKLIPSE methodology

The European Commission requested the EKLIPSE H2020 project to help building up an evidence and knowledge base on the benefits and challenges of applying NBS. The aim of this EKLIPSE activity is to devise an impact evaluation framework that can guide the design, development, implementation and assessment of NBS demonstration projects in urban contexts, like URBAN GreenUP project.

The result of the EKLIPSE activities is a methodology to evaluate NBSs based on 10 challenges:

- 1. Climate mitigation and adaptation;
- 2. Water management;
- 3. Coastal resilience;
- 4. Green space management (including enhancing / conserving urban biodiv.);
- 5. Air/ambient quality;
- 6. Urban regeneration;

- 7. Participatory planning and governance;
- 8. Social justice and social cohesion;
- 9. Public health and well-being;
- 10.Potential for new economic opportunities and green jobs.

For each challenge, a set of KPIs to measure NBSs impacts at different scales (micro-scale, meso-scale and macro-scale) has been individuated.

URBAN GreenUP aims to integrate the EKLIPSE methodology with the Ecosystem Services Approach (ESA) in order to generate a homogeneous evaluation framework to be adopted by cities during the project. This framework is based on the ecosystem services produced or enhanced by NBSs.

# 1.1.2 Ecosystem Services Assessment methodology (ESA)

Ecosystem services are "the direct and indirect contributions of ecosystems to human wellbeing". Building on previous categorizations of ecosystem services the TEEB report identifies 22 types of ecosystem services grouped in four categories:

- 1. provisioning;
- 2. regulating;
- 3. supporting;
- 4. cultural.

URBAN GreenUP project in order to evaluate impacts and trade-offs of NBSs implemented in front-runner cities will adopt the Ecosystem Services Assessment (ESA) approach. ESA approach is based on urban ecosystem services. The grid and classification of urban ecosystem services will be further refined and finalized during next steps of URBAN GreenUP project and through the involvement of the demo sites cities Liverpool, Izmir and Valladolid.

Nature-based solution	Ecosystem Services	
Sustainable Urban Drainage Systems (i.e. ponds and wetlands)	Waste regulation (water) Runoff mitigation Air filtration	Micro-climate regulation Aesthetic beauty





Nature-based solution	Ecosystem Services		
Phytoremediation and	Waste regulation		
phytostabilisation	(soil and water)		
Biodegradation and bioconversion	Disease reduction		
Green roofs/walls	Runoff mitigation	Erosion control	
	Air filtration	Aesthetic beauty	
	Micro-climate-regulation		
Tree planting alongside roads	Air filtration		
	Micro-climate-regulation		
	Aesthetic beauty		
Urban greenspace	Air filtration	Disease reduction	
	Micro-climate-regulation	(establishment of	
	Erosion control	vectorfeeding species)	
	Pollination and seed	Aesthetic beauty	
	dispersal Outdoor recreation		
		Cognitive development	

Table 1.1: Draft grid of ecosystem services affected by urban NBS (source: UB-IEFE, 2016)

# **1.1.3 KPIs design process**

The KPIs creation process in URBAN GreenUP has been developed taking into account also frontrunner cities and our capacity to adopt and use the set KPIs proposed.

The 70 initial KPIs pre-selected for URBAN GreenUP have been categorised based on the ecosystem services categories:

- 16 for the evaluation of cultural services;
- 6 for the evaluation of provisioning services;
- 39 for the evaluation of regulating services;
- 9 for the evaluation of supporting services.

In total, the KPIs individuated are 151. The table below summarizes the KPIs selected by each city and the categorization of the KPIs per "challenges" (based on the EKLIPSE methodology) and per ecosystem services category (based on the ESA methodology).

EKLIPSE Challenges	KPIs (Number)	Ecosystem services measured	Valladolid	Core KPIs selected
1 Climate mitigation & adaptation	15	regulating	3	4
2 Water Management	24	regulating supporting provisioning	13	8
3 Costal resilience	12	regulating supporting cultural	-	-
4 Green space management	27	provisioning supporting cultural	6	5





EKLIPSE Challenges	KPIs (Number)	Ecosystem services measured	Valladolid	Core KPIs selected
5 Air quality	14	supporting regulating	4	5
6 Urban Regeneration	18	regulating supporting cultural	2	2
7 Participatory Planning and Governance	7	cultural	2	1
8 Social Justice and Social Cohesion	10	cultural	-	1
9 Public Health and Well- being	12	cultural regulating	-	2
10 Potential of economic opportunities and green jobs	12	/	4	1
	151		34	29

Table 1.2: KPIs for NBSs evaluation in Valladolid (source: UB-IEFE, 2017)

Front-runner cities will have the possibility to use additional specific KPIs during the monitoring phase.

This **Valladolid Demo-Site Baseline** is helping to define the real enforcement of KPIs pre-defined in the initial phases, as it was settled then. We provide real data available and measurement methods applied, but also expected data in the URBAN GreenUP project, or capable of being calculated in Valladolid.

In Annex I the list of EKLIPSE Challenges and KPIs pre-selected for the city of Valladolid can be found.

See Annex I. KPIs pre-selected for Valladolid.



# 2 Predefinition of zones and sub-demos

The following is a general description of the interventions planned for the municipality of Valladolid within the URBAN GreenUP project in the three Sub-Demo Areas (A, B, C). It is worth saying that the actions definitive locations have not been determined yet; therefore, the images in this point are only graphic representations.

It is important to highlight some non-technical interventions for engagement, city coaching and support activities, that will be developed in the three Sub-Demo Areas indistinctly. Non-technical interventions will also serve to support the development of the technical interventions, and the definition of the city an Urban Learning Laboratory.

With the aim to facilitate the achievement of the objective of the project regarding the development of a methodology to support the co-development of Renaturing Urban Plans (RUP) following a holistic approach, the three Sub-Demos areas have been chosen. These three areas are inter-connected, so all the interventions in the city can be considered as a whole and the final result as a RUP of a part of the city. The experiences learnt in the process of the development will improve the process, and serve as basis of other future RUPs in the city of Valladolid.

Moreover, the different three demos have different characteristics which made the election very interesting. The different locations of the interventions have predominant factors and trends which cover different realities within the city. Therefore, the different approaches often enrich the project:

- The Natured Based Solutions located in the city centre, sub-demo B, will show the benefits of the re-naturalization to the citizens and tourist or visitors, which serve to facilitate the engagement and promotion of ecological reasoning and ecological intelligent. In this area, it will be also easy to involve the private sector in the development of the NBS: co-financing, co-design, co-creation, sponsoring... because this collaboration is a good opportunity for companies to enhance their corporate social responsibility. The benefits of the involvement of the private sectors will carry out important benefits: wider availability of information and diffusion of NBS impacts, enhancement of the replicability of the project, improvement of solutions definitions thanks a co-designing processes, enriching content and establishment of the methodology for the development of RUPs...
- The two areas located in the periphery of the city, belonging to sub-demo C, need to be renovated to solve technical problems in the pavements, infrastructures or orchards, for example. Thanks to the implementation of different NBS, related to water and green infrastructures, these sub-demos will be improved and will serve for public recreation, in which the citizens will feel closer to the nature. The more available space for these interventions will allow to create also educational paths to support educational activities with all the sector of the city population: from children to elderly people. Co-creation activities will be developed also in the urban orchards because this spaces easily promote the participation of the citizens.





• The green corridor inter-connects all the interventions, and will provide to the city a green east-west route with high impact in the current mobility systems and the biodiversity of the city. The integration of all the NBS in the city in a whole, thanks to the green corridor, it is very important in order to consider the URBAN GreenUP project as a Renaturing Urban Plan, and not only a sum of different interventions in different locations of the city. This can establish a methodology in the development of a strategy to implement and improve these initiatives.

#### Sub-Demo A "Valladolid Urban Green Corridor"

The proposed green corridor will serve as an important communication route between the City Centre and other populated areas with important recreational areas from the Zorrilla football stadium in the West, to the new floodable park in the East, seeking to facilitate sustainable transport in the city in a transversal axis and provide important ecosystem services for urban biodiversity.



Figure 2.1: Aerial view of Sub-Demo A "Urban Green Corridor"

The Nature Based Solutions (NBS) of Sub-Demo A are:

- New green cycle lane with cycle-pedestrian green paths areas, with green resting areas, and some natural pollinator's modules.
  - Plantation of trees along the Green Corridor, over smart soils as substrate.
  - Installation of a tree shady place in funfair site next to Zorrilla football stadium.
  - Construction of SUDs for the green cycle lane.
  - Green noise barriers along the Valladolid Urban Green Corridor.

#### Sub-Demo B "City Centre - NBS to reduce heat island effect and improve air quality"

It will be deployed in the City Centre of Valladolid. This Sub-Demo B includes different types of green infrastructure (GI) that will reduce maximum/averages temperatures, will increase relative humidity and will reduce air pollutants. In this zone, it will be used NBS adapted to high-urbanized areas.







Figure 2.2: Aerial view of Sub-Demo B "City Centre"

The Nature Based Solutions (NBS) of Sub-Demo B are:

- Plantation of shade and cooling trees in City Centre, over smart soils as substrate.
- Vertical green infrastructures such as Vertical Mobile Garden and a Green Façade.
- Horizontal green infrastructures such as a Green Roof and Green Covering shelters.
- Electro wetland surface which can provide electricity.
- Green-shady structures in streets from the City Centre.
- Green noise barriers in different places with high levels of noise.
- Compacted pollinator's modules installed in mobile window boxes

# Sub-Demo C "Retrofit urban ecosystems to improve well-being and to avoid flood risk. New models of re-naturing urban areas"

It includes a set of actions that will develop sustainable GI with a high ecological value and low maintenance costs. This Sub-Demo C will be deployed in different locations in Valladolid; for that reason, we divide Sub-Demo C into four:

• C1.- Football Stadium area (Parking)

The Zorrilla parking surface is being renaturalized with green pavements of high drainage capacity and creeping grass; and the plantation of trees. It will be completed with the installation of SUDs and a rain garden.

• C2.- Football Stadium area (Sustainable park)

A Natural Wastewater Treatment Plant will be installed inside of an urban park as a model of a source of sustainable water for irrigation, close to the Football Stadium.

• C3.- Floodable park area

A floodable park at the entrance of Esgueva River in the city will integrate several NBS to minimize flooding risks and provide co-benefits to Climate Change such as water storage, biodiversity, quality public spaces, health, and wellbeing for citizens.

# • C4.- Alameda park area (Urban farming)

In Alameda Park area, urban farming facilities will be constructed.





 Image: Contract of the second of the seco

The Nature Based Solutions (NBS) of Sub-Demo C in its different subdivisions are:

Figure 2.3: Aerial view of Sub-Demo C Football Std area - C1 "Parking" and C2 "Sustainable Park"

# C3.- Floodable park area (Esgueva River)

C1.- Football Stadium area (Parking)

- $\mathbf{P} \bullet \mathbf{G}$  reen pavement of near 2,000 m<sup>2</sup>.
- SUDs and a Rain Garden.
- Plantation of trees to re-naturing Football Stadium parking, over smart soils as substrate.
- C2.- Football Stadium area (Sustainable park)
- Natural wastewater treatment plant (NWTP).
- Plantation of trees in a sustainable park, using smart soils as substrate, with compacted pollinator's modules and an educational path.



Figure 2.4: Aerial view of Sub-Demo C3 "Floodable Park"

- Floodable park of near 40,000 m<sup>2</sup>.
- Green filter area with trees which will filter Esgueva River water.
- Urban Carbon Sink, with the plantation of trees with high capacity of Carbon sequestration.
  - Urban orchard area in the Floodable park zone and an educational path.





and

#### C4.- Alameda park area (Urban farming)



Figure 2.5: Aerial view of Sub-Demo C4 "Urban farming in Alameda Park"

#### Non-technical interventions

- Engagement portal for citizens, sponsoring activities, a single desk for RUP deployment, • and mentoring and supporting to citizen projects of NBS.
- Promotion of ecological reasoning and intelligence. •





# 3 Challenges and Limitations

We consider challenges and limitations related to Regulations at European, national, regional and local level (E, N, R, U); and then Other types of challenges and limitations classified into six types: Public management, administrative, technical, economic, environmental and social issues.

The challenge and limitations depends on a variety of factors, which can be divided into two groups:

- Type of NBS: technical complexity level, costs, previous knowledge, specific regulation...
- Location: site regulation, impact on citizens, political decisions, available space...

However, other challenges and limits are common to all NBS and locations, mainly included in Public management and administrative types.

In the different sections of this Chapter 3. *Challenge and limitations*, examples related to some NBS to be implemented are explained; the *Annex III* is a summary which ones applies to each NBS.

The three selected sub-demos present different challenges and limitations, and the way to face them and the process to find solutions to successfully achieve with the objectives of the projects are also different. This variety of situations will improve the experience in the development of RUPS of the Valladolid City Council, and will serve to replicate similar initiative's in other cities and scenarios.

The sub-demos where the NBS will be implemented are defined, and the challenge and limitations of the different NBS and locations are identified. In the following steps of the project, during the development of NBS processes (decision making, design, construction works, monitoring...) the Valladolid City Council but also the stakeholders involved, will try to address these difficulties and establish a methodology, where non-technical actions and co-creation activities will act as mechanism to improve it. This learning process will be included in the following reports and deliverables included in this WP2, but also the conclusions achieve will be part of the work to be developed in other WP.

# 3.1 Regulations

The following is a list of the regulations classified by groups according to the nature of the NBS. In Annex II the information in detail is shown. For each Regulation, the download link (source) is provided as well as the application requirements for each NBS.

#### See Annex II. Regulations in Valladolid.

At the end of this paragraph, a list of good practice Manuals and Official Guides is included.

## New green cycle lane and re-naturing existing bike lanes

• Regulatory Ordinance of Bicycle Mobility in Valladolid Municipality (BOPV nº 67, 21st March 2015).





• Comprehensive Urban, Sustainable and Safe Mobility Plan for the City of Valladolid (PIMUSSVA). Valladolid City Council has a Sector Program: Empowering non-motorized modes (Cyclist and pedestrian).

# Tree related actions

- Royal Decree 1628/2011, 14th November, List and Spanish Catalogue of Exotic and Invasive Species (BOE nº 298, 12th Dec 2011). This decree will serve as a base to know the list of species that cannot be considered to introduce due to their invasive nature (Annex I, Annex II).
- Royal Decree 1311/2012, 14th September, Sustainable use of plant protection products. This Decree establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides. This Royal Decree comes from a European Directive<sup>1</sup>.
  - This should be applied to all Green Infrastructures.
- Law 5/1999, 8th April, of Urban Planning of Castilla y León. Regional regulation that establishes in its Article 97, which acts are subjected to licence.
- General Urban Planning Plan (Plan General de Ordenación Urbana, PGOUVa 2012). In the PGOUV last version, the creation of a sustainable network of public green spaces where trees, roads and squares could take part of an ambitious system that aims to integrate the urban and the metropolitan ambit was planned. Also general orientations for trees management are defined.
- Parks and Gardens Regulation of the City of Valladolid (BOP, 14th March 1990). The municipal regulation establishes that in sidewalks with a width of more than three meters, the ditch shall never be less than 0.80 x 0.80 meters, to facilitate the collection of both irrigation and rainwater. Also, in sidewalks with a width of less than three meters, for the small trees, the minimum dimension shall be 0.60 x 0.60 meters. Finally, the edges of the ditch must be at the same level as the sidewalk to facilitate the collection of rainwater.

#### **SUDs**

- Water Framework Directive (2000/60/EC) (Official Journal (OJ L 327) on 22<sup>nd</sup> December 2000). For the protection and improving of water bodies at European level.
- EU Floods Directive (2007/60/EC). Requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk.
- Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, 20th July. Public Water Domain regulation, water use and competences.

<sup>&</sup>lt;sup>1</sup> Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides (Text with EEA relevance).





- Regulation of the Public Hydraulic Domain which develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20th July. Definition of the hydraulic public domain and its use and protection.
- Hydrological Plan of the Duero river basin district, approved by Royal Decree 907/2007 of 6th July.
- Royal Decree 903/2010, of Evaluation and Management of Floods Risks.
- Technical Code for the Construction (CTE-DB-HS). Royal Decree 314/2006. This regulation contains recommendations about facilities for the reuse of rainwater in domestic uses.
- Regulations for Water Supply and Sanitation in the city of Valladolid (April, 2006). This local Ordinance contains rules for sewage water discharge into the municipal sewerage of Valladolid.

# Natural Wastewater Treatment Plant

- Water Framework Directive (2000/60/EC) (Official Journal (OJ L 327) on 22<sup>nd</sup> December 2000).
- Urban Wastewater Treatment Directive (91/271/EEC). It contains water discharge limits and also N and P limits in sensitive areas, at European level.
- Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, 20th July.
- Regulation of the Public Hydraulic Domain which develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20th July.
- Hydrological Plan of the Duero river basin district, approved by Royal Decree 907/2007 of 6th July.
- Royal Decree Law 11/1995, for Urban Wastewater treatment.
- Royal Decree 509/1996, which complements the RD Law 11/95, and its modification through the RD 2116/1998. It contains the limits for water discharge.
- Resolution of 30<sup>th</sup> of June 2011 which declares sensitive areas in transboundary river basins.
- Royal Decree 1620/2007, Regulations for Water Reuse. This regulation contains the potential reclaimed water uses depending on the water quality (i.e, for irrigation).
- Regulations for water supply and sanitation in Valladolid city (April, 2006)
- Royal Decree 1311/2012, 14<sup>th</sup> September, sustainable use of plant protection products. It applies to every green NBS with vegetation.

## Rain gardens

- Water Framework Directive (2000/60/EC) (Official Journal (OJ L 327) on 22<sup>nd</sup> December 2000).
- EU Floods Directive (2007/60/EC).
- Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, 20th July.





- Regulation of the Public Hydraulic Domain which develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20th July.
- Hydrological Plan of the Duero river basin district, approved by Royal Decree 907/2007 of 6th July.
- Royal Decree 903/2010, of Evaluation and Management of Floods Risks.
- Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.

# Green filter area

- Water Framework Directive (2000/60/EC) (Official Journal (OJ L 327) on 22<sup>nd</sup> December 2000).
- Urban WWWT Directive (91/271/EEC).
- Royal Decree Law 11/1995, for Urban Wastewater treatment.
- Royal Decree 509/1996, which complements the RD Law 11/95, and its modification through the RD 2116/1998
- Resolution of 30th of June 2011 which declares sensitive areas in transboundary river basins.
- Royal Decree 1620/2007, Regulations for Water Reuse.
- Regulations for water supply and sanitation in Valladolid city (April, 2006).
- Action Plan for Pollution Alert of Valladolid (BOPV 4th April 2017). Adoption of three alert situations for the pollution control of the city of Valladolid: Situation1: Preventive; Situation 2: Notice; Situation 3: Alert.
- Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.

# Floodable Park

- Directive 2007/60/EC on the assessment and management of flood risks. Aims to include the promotion of sustainable land use practices, improvement of water retention as well as the controlled flooding in the case of a flood event.
- Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20 July.
- Regulation of the Public Hydraulic Domain which develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text, approved by Royal Legislative Decree 1/2001, of 20<sup>th</sup> July. A prior administrative authorization from Confederación Hidrográfica del Duero (Duero Hydrographic Confederation) must be requested.
- Hydrological Plan of the Duero river basin district, approved by Royal Decree 907/2007 of 6th July.
- Royal Decree 903/2010, of 9 July, on the assessment and management of flood risks. About Flood risk management plans; that may also include the improvement of water retention in case of a flood event.
- Basic Guideline for Civil Protection Planning for Flood Risk approved by Agreement of the Council of Ministers of January 31, 1995.
- Flood Risk Management Plan of the Duero's basin, approved by Royal Decree 18/2016, of 15 January.





• Civil Protection Plan for Flood Risk in the Autonomous Community of Castilla y León (INUNcyl) (BOCYL 3 March 2010).

# Green parking pavements

• Comprehensive Urban, Sustainable and Safe Mobility Plan for the City of Valladolid (PIMUSSVA). Sector Program: Road and Parking, from Valladolid City Council.

# Smart soils and substrates

• Royal Decree 865/2010, of 2nd July (last modification 28th July 2012) on growing substrates. There is no specific soil protection legislation in the EU.

The proposed Directive for soil protection is stagnant in the first reading phase. This proposal is the result of recognition from the V Environmental Action Program of the soil as a specific environmental asset. The so-called Thematic Strategy for Soil Protection was developed within the framework of action of the Sixth Program, which led to the drafting of the aforementioned Proposal.

Only nine Member States of the EU have specific legislation on soil protection and it is specific legislation for the problem of soil contamination. Due to the importance of the negative effects of soil degradation, the European Commission adopted a thematic strategy on soil (Implementation of the Soil Thematic Strategy (COM (2006) 231, 22.09.2006), which aims to protect and ensure the sustainable use of the soil by restoring degraded soils and a proposal for a Framework Directive on soil (COM (2006) 232), 22.09.2006) in order to protect European soils.

## Pollinators modules

- Royal Decree 630/2013, of 2nd August, which regulates the Spanish Catalogue of invasive alien species. Ministry of Agriculture, Food and Environment.
- Royal Decree 139/2011, of 4th February, for the development of the List of Wild Species in Special Protection Regime and the Spanish Catalogue of Threatened Species.
- Royal Decree 1311/2012, 14th September, plant health products sustainable use.

# Vertical and Horizontal green interventions

Related to Noise:

- Law 37/2003 of 27th November, on Noise. Emission or immission limit values as well as noise and vibration assessment procedures and methods.
- Law 5/2009 of 4th June, on Noise in Castilla y León. Acoustic quality objectives for Castilla y León region. Limits of emission and immission defined in Annex I.
- Ordinance on Noise and Vibrations of Valladolid (BOPV n° 122, 31th May 2013). The limits of emission and immission shall be as defined in Annex I of Law 5/2009, of the Noise of Castilla y León.
- Municipal Plan against Noise Pollution of Valladolid (2008).

Related to constructions in the public thoroughfare and historic centre:

• Royal Decree 1372/1986, of 13th June, on the Regulation of Goods of Local Entities.





- Regular Fiscal Ordinance of Taxes for Private or special use of the Municipal Public Space. Chapter 6: Regulation of the rates for occupation of the public road.
- Special Plan of the Historic Quarter, General Urban Planning Plan of Valladolid (BOPV, 27th Feb 2004)
- General Plan of Urban Planning (PGOU) Article 72. Partial actions of conservation, repair and adaptation of façades.

Related to green infrastructure constructions:

- Technical Building Code, CTE-DB-SI. CTE-DB-SI2, 1.4 -The fire reaction rate of materials occupying more than 10% of the surface of the exterior finish of the façades or of the interior surfaces of the ventilated chambers shall be B-s3, d2.
- Technical Building Code, CTE-DB-SE. CTE-DB-SE1, 4.4- It is considered that there is sufficient strength of the supporting structure, of a structural element, section, point or of a union between elements, if for all the relevant dimensioning situations the following condition is fulfilled: Rd ≤ Ed; where Ed: calculation value of loads, Rd: value of resistance calculation.
- Technical Building Code, CTE-DB-HS. CTE-DB-HS1, 2.3.1 and 2.3.2 The degree of impermeability of the façade must be 2, and its coating must have a medium resistance to filtration.
- Regulation of potable water supply and sanitation municipal service (BOPV 26th April 2006)
- Royal Decree 1628/2011, 14th November, List and Spanish Catalogue of Exotic and Invasive Species (BOE nº 298, 12th Dec 2011)
- Royal Decree 1311/2012, 14th September, plant health products sustainable use.

# Electro wetland

- IEC 60529:1989/A2:2013 Degrees of protection provided by enclosures (IP Code). International Electro technical Commission. About electrical protection.
- Law 5/1999, 8th April, on Urban Planning in Castilla y León. Art.97Acts subject to license. Require obtaining urban planning license, without prejudice to other interventions, acts of use that exceed the normal use of natural resources.
- Regulation of potable water supply and sanitation municipal service (BOPV 26th April 2006). Title III.- Use of the sewer system. Annex III.-Discharge limits to the public sewer system

## Non-technical interventions

- Decree nº 2369, 7th April 2016, on Bases for the Ecological Gardens Proposals 2016-2017. Criteria for access and use of ecological orchards for the unemployed and community-based orchards (associations). The space ceded will be devoted exclusively to the practice of ecological horticulture<sup>2</sup>.
- Royal Decree 1311/2012, 14th September, plant health products sustainable use.

<sup>&</sup>lt;sup>2</sup> http://www.valladolid.es/es/actualidad/noticias/huertos-ecologicos-2016-2017





- Environmental Education Strategy in Castilla y León (Castilla y León Regional Government, 2003)
- Municipal Environmental Education Program (Local Agenda 21). Addressing the environmental problems generated by our model of life fundamentally urban and the human problems derived from these environmental impacts, through speeches, courses and guided visits.
- Law 19/2013, of 9th December, on Transparency, Access to public information and Good governance.
- Law 37/2007, of 16th November, on the Re-use of information from the public sector (Modified by Law 18/2015, of 9th July). The reuse of the information generated by Local Entities has the fundamental objective of the creation of public value in society.
- Ordinance on Transparency, Access to information and its Reuse (BOPV n° 214, de 16th September 2016). Systems to integrate the management of citizens requests for information, through information technologies (IT).

# 3.1.1 Guides and manuals

- Manual for Wastewater Treatment Systems implantation in small communities (CEDEX & CENTA, 2010). Design specifications of horizontal subsurface constructed wetlands.
- Practical Manual for Wastewater Treatment in small municipalities (CHD, 2013). Chapter 5.- Wastewater treatment technologies applicable to small municipalities.
- Guide for vegetation in riparian zones of the Duero river basin (CHD, 2008).

# 3.2 Other challenges and limitations

This paragraph describes general Challenges and Limitations to be addressed in the design, construction, implementation and maintenance of the actions planned in URBAN GreenUP in the city of Valladolid.

Challenges and Limitations area classified into 6 Categories: Public management, administrative, technical, economic, Environmental and Social.

The general descriptions can be found here. But in Annex III the information in detail is shown, grouped by every Nature Based Solution type.

#### See Annex III. Challenges and Limitations in Valladolid.

## 3.2.1 Public management

Four main challenges and limitations were identified regarding public management, which are the slow periods for public tendering and processing, which may generate delays in the project chronogram.

Second, those local regulations (licenses, ordinances) may not be adapted to these types of green solutions (e.g. vertical gardens anchoring to façades).

In third place, it is also Valladolid City Council's responsibility the definition of the placements for the different actions.



The access to financial resources sometimes can be difficult and the approbation process slow, which can delay the development of implementations.

Finally, the responsibility that the public administration, Valladolid City Council, will have in terms of NBS maintenance, both during the project period (2017-2022) and after it.

# 3.2.2 Administrative

Several administrative limitations can result in delays of project's chronogram:

- Internal coordination issues among Valladolid City Council Areas responsible for the permits emission and NBS control and maintenance: Urban Planning, Infrastructures, Environment, Parks and Gardens and Innovation Agency, among others;
- 2) Coordination issues regarding the internal organization of each area, especially Urban Planning and Environment;
- The slow process for administrative licenses and authorizations (if applicable) such as public thoroughfare occupation, water discharge point, or vegetation disease control products enforcement;
- 4) Lack of correspondence between the URBAN GreenUP project and the Political agenda could also interfere in the proper deployment of the planned actions.

# 3.2.3 Technical

Every Nature Based Solutions type has its own technical challenges and limitations. Lack of space to develop the NBS is one challenge that many actions might have (cycle lane, SUDs, electro wetland, pollinator's modules, green shelter, urban garden bio-filter, even tree related actions, among others).

*Tree related actions* seasonality might condition the most suitable planting timeframe, which might not coincide with the project chronogram. Selected trees must foster local biodiversity, thus local and not allergenic species must be prioritized. It must be considered that trees root growth might have negative impact towards different pavements (streets, roads and sidewalks).

In order to control pest and vegetation diseases phytosanitary products must be applied. The challenge comes from the fact that only biological products and biological control strategies can be used in public spaces.

Probably there will be few construction companies with demonstrated experience in the construction of SUDs, rain gardens, green parking pavements or other NBS in the local area. In water NBS (like Natural Wastewater Treatment Plant – NWTP – or electro wetland), connection to the city sewerage to conduct water might be a problem.

*Floodable park* area has also some technical challenges. There is an electric line crossing the plot where it is going to be located. It is a challenge to calculate exactly the spillway height so that it begins to derive part of the water flow in the moment, just before the water starts flooding throughout some zones of East Valladolid. Also in the floodable park area, there is not water supply system, so there is a need to solve how to irrigate green zones, plants and trees.





# 3.2.4 Economical

Some of the NBS will need maintenance operations which could have not been considered into the initial budget: Green parking pavements, tree related actions, vertical and horizontal green interventions, NWTP, electro wetland, urban garden biofilter, among others.

In order to guarantee the evaluation of the foreseen NBS within project duration, in *Tree related actions,* grown trees should be planted. Grown trees can help to achieve better results in the monitoring period, related mainly to the following challenges: Air Quality, Public Health and Well-being, and Green Space Management. This might result in an increase in cost per tree planted, so it might affect either the initial budget or the number of trees per NBS finally planted. Potential pest affections in planted trees, which shall be replaced, can result in non-considered increases of the budget. Therefore, it will be important also to consider the plantation of smaller trees, because they can grow and become stronger and more robust trees, better adapted to the place.

In the case of *Floodable park area*, budget needed to carry out the works required for a proper design of the floodable park and its auxiliary elements is expected to be higher than the available budget. Also expected cost of Green cycle lane might not cover the initial km planned, so it might have been not correctly dimensioned.

Finally, *non-technical actions* such as Urban farming promotion or Educational activities have not been considered into the initial budget. Calculate real implementation cost is needed.

# 3.2.5 Environmental

There is the requirement to select *vegetable/arboreal species* that guarantee NBS functionalities all over the year under climate conditions in Valladolid. Also autochthonous, non-invasive and non-allergenic vegetation must be selected. Regulations regarding the application of phytosanitary products depending on weather conditions and the infestation degree, can become and environmental limitation. Also the climatologic constraints can affect NBS proper deployment and planting (because of the limitations of every vegetation type)

*Natural Wastewater Treatment Plant* will produce CH4 emission and other GHG in the primary treatment (septic tank or Imhoff tank). Also sewage sludge production (although small) will need a proper management.

The *electrowetland* construction will boost urban biodiversity by opening a new green area that might attract different fauna; whose change in urban fauna in the city shall be contemplated by the municipality responsible. Also, there are risks of plant decay during winter.

# 3.2.6 Social

Main social challenge found is that citizens do not know what NBS or Green infrastructure are, they are not aware of their benefits versus Gray infrastructure; and in the end, the citizens are directly affected by the local NBS. This could lead to citizen rejection.

Selected trees and vegetation must have no negative health effect in terms of allergenic agents released to atmosphere. The establishment of some bird flocks in tree based areas might cause





noise disturbance and negatively affect the cleanliness of the surrounding public area. Also some actions might cause bad odours (NWTP, smart soils,

Vandalism can become also a challenge. In tree related actions and vegetation actions, vandalism might be a problem especially at the beginning of the actions deployment, when the integrity of the vegetation can be more affected.

*Green cycle lane* might have difficulties in the coexistence of the pedestrian with the cyclist in crossing areas and in cycle-streets.

Urban farming promotion and education activates necessarily need people collaboration. There might be a lack of citizens available for the operation and maintenance of urban gardens. Also the orchards users must agree a series of ethical commitments.





# 4 Baseline situation

This paragraph contents the baseline calculated of the current situation to support the evaluation process during URBAN GreenUP Project. Data is available for every Sub-Demo Site of Valladolid:

- Sub-Demo A: Green Corridor. Actions to re-nature the concept of cycle lane in Valladolid.
- Sub-Demo B: City Centre. Actions to re-nature areas with low availability of space for conventional Green infrastructure.
- Sub-Demo C: New models of re-naturing urban areas. It is divided into four main locations:
  - C1. Football Stadium area (Parking). Actions to re-nature the concept of outdoor car parking.
  - C2. Football Stadium area (Sustainable Park). Actions to create a sustainable park from different points of view but mainly from the use of water for irrigation.
  - $\circ~$  C3. Floodable Park area. Actions to create a floodable park in Valladolid.
  - $\circ~$  C4. Urban farming (Alameda Park). Urban farming and related actions.



Figure 4.1: Aerial view of the three Sub-Demo Areas of URBAN GreenUP in Valladolid

Every Sub-Demo Site (A, B, C) is also divided into sub-zones, in groups according to the nature and location of the Nature Based Solutions. In every sub-zone there is a general description of the status of the area, then the NBS are described, and at the end the baseline calculation of the area is included.

In every "Baseline Calculation" section, we will define the baseline calculation of the area and provide data values collected from current sources, but also expected data resulting from the URBAN GreenUP project, which is not available yet. In some cases, expected data will be provided from bibliography sources.

#### See Annex IV. NBS Groups > KPIs > Data.



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# 4.1 Subdemo A "Green corridor"

Valladolid has currently a quite extensive bike lane network, although among the objectives of its Sustainable Urban Mobility Plan is improving connectivity for present network.

This green corridor will improve landscape connectivity between green areas and providing very important ecosystem services for the promotion of urban biodiversity and sustainable mobility. It will include plantation and renovation of tree series and shady trees, development of green resting areas, SUDS (sustainable urban drainage systems), green noise barriers and pollinators modules.

Sub-Demo A "Green Corridor" is divided into the following sub-zones:

- a) New green cycle lane and re-naturing existing bike lanes.
- b) Tree related actions.
- c) Natural pollinator modules.

## 4.1.1 New green cycle lane and re-naturing existing bike lanes

#### Current status of the area



The bike lanes network in Valladolid is quite extensive but has problems of non-connection between the different existing bike lanes. In the network you can observe up to three areas very separated from each other (West, East and San Cristóbal industrial area)<sup>3</sup>.

Valladolid has the <u>Vallabici</u> bicycle loan public system from 2013, which has 30 points of bicycles loan distributed throughout the city.

Figure 4.2: Current cycle lane in Valladolid (Valladolid City Council, 2010)

## NBS description

VAc1-New green cycle lane and re-naturing part of existing bike lane.
It is foreseen the deployment of 5km of new green cycle lane and re-naturing 3km of existing bike lane. This intervention integrates other NBS (VAc2, VAc3, VAc6, VAc8, VAc15, VAc16, VAc19 & VAc22), which will allow the development of a real green corridor into the city. This corridor will be a natural biodiversity line, which will connect isolated green areas in the city.

<sup>&</sup>lt;sup>3</sup> Comprehensive Urban, Sustainable and Safe Mobility Plan for the City of Valladolid (PIMUSSVA, <u>Non-mothorized</u> <u>modes program</u>, 2015).





VAc6- Installation	Installation of 3 resting areas with a tree shade area, a small pollinator module, a bike parking, resting structures (benches/green slopes) and a fountain.
of 3 Green Resting areas	It will be installed 3 resting areas, next to Campo Grande Park in the city centre, in the Football Stadium zone and in Floodable park. Each resting area will have 100 m <sup>2</sup> , a tree shade area, a small pollinator's module, a bike parking, resting structures (benches/green slopes) and a fountain.
VAc15- Cycle-	Installation of Cycle-pedestrian green paths areas with green pavements in a special structure with filter properties.
pedestrian green paths	The installation of 3 cycle-pedestrian green paths areas (1,000 m <sup>2</sup> ). VAc15 includes green pavements in a special structure with filter properties (small gaps filled with smart soil and with specific creeping grass species with a short growing and minimum maintenance). These features will allow manage water runoff and it could serve in the cycle-pedestrian areas to reduce cycle speed in specific urban sections with many pedestrians. These sections of pavements will indicate slow velocity zones in street crosses, pedestrian stops, etc.
VAc8-SUDs for green bike lane	Installation of SUDs for managing and treating surface water runoff in green bike lane area.
	It is foreseen to install 7 units of SUDs (50 m <sup>2</sup> each) for managing and treating surface water runoff in the cycle lanes of green corridor. Selected streets have asphalt pavement and these drainage systems will improve management of small floods from storms. SUDs do not need maintenance due to their sustainability. Native and adapted plants will be installed being another biodiversity spot.
VAc16-	Innovative soil with auto-fertilizing and NOX fixing properties.
Smarts soils as substrate	Smart soils for cycle-pedestrian green paths, pollinator's modules and green shady structures (SubDemo A). It will be used along this SubDemo A in VAc2, VAc15 and VAc19 (384 m <sup>2</sup> ).

Table 4.1: NBS of Sub-Demo A "Green cycle lane"

## Baseline calculation of the area

The implementation of these NBS along Green cycle lane will account for several impacts regarding the environmental and social challenges established in EKLIPSE<sup>4</sup>. EKLIPSE challenges are quantified by means of different KPIs. The initial calculation of the corresponding KPIs will define the baseline of the area and provide some values of the expected data resulting from the URBAN GreenUP project. The positive effect of the aforementioned NBSs within the city can be quantified by means of the following KPIs.

<sup>&</sup>lt;sup>4</sup> Raymond, C.M., Berry, P., Breil, M., Nita, M.R., Kabisch, N., de Bel, M., Enzi, V., Frantzeskaki, N., Geneletti, D., Cardinaletti, M., Lovinger, L., Basnou, C., Monteiro, A., Robrecht, H., Sgrigna, G., Munari, L. and Calfapietra, C. (2017) An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects. Report prepared by the EKLIPSE Expert Working Group on Nature-based Solutions to Promote Climate Resilience in Urban Areas. Centre for Ecology & Hydrology, Wallingford, United Kingdom




Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 1: Climate mitigation & adaptation	Carbon savings per unit area Carbon storage and sequestration	CO <sub>2eq</sub> emissions Avoided: CO <sub>2eq</sub> emissions avoided considering a life cycle approach and modelling the environmental impacts regard to indirect savings	(tCO2eq /year)

This indicator, related to the climate change mitigation, will be calculated using a methodology that has yet to be defined completely properly. There are several possibilities to do it but to make the initial calculations of the expected impact we used IPCC 2013 GWP 2010a methodology. Considering a life cycle approach and modelling the environmental impacts regard to indirect savings.

After defining the proper methodology to be used (it will be studied in coming months and discussed among all demo partners in the project), collection data about users and uses during the project will be carried out before and after the implementation.

For the calculation of the baseline for this intervention will be used data from the mobility studies and reports of Valladolid City Council.

### CHALLENGE 2: Water management.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 2: Water	Physical indicators	Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)
management		Absorption capacity of green surfaces, bioretention structures and single trees (m <sup>3</sup> /m <sup>2</sup> ) (m <sup>3</sup> /tree)	(m³/m²) (m³/tree)

These indicators are directly related to the infiltration/drainage capacity of Green surfaces (vegetation), soils and trees retention, and specifically of SUDs (VAc8). They could be assessed at local level (or higher) for the quantification of run-off coefficient at city or local flood risks reductions

The methodology for calculating it is not established but there are references that are being discussing at NBS European projects level in Task force groups promoted by EASME and EU Commission. URBAN GreenUP will adopt the methodology selected and will determine the baseline.

#### **CHALLENGE 4: Green Space Management**

Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 4:	Social indicators	Accessibility (measured as distance or	
Green Space	(benefits)	time) of urban green spaces for	(m) (min)
Management		population	





	Weighted recreation opportunities provided by Urban GI.	(nº)
	Distribution of public green space –	(m2/capita)
	total surface or per capita.	(
Environmental	Increased connectivity to existing GI	(% increased
(biological)	increased connectivity to existing of	km <sub>cycle lane</sub> )
	Pollinator species increase (number)	(nº) (%)
	Sustainability of green areas	
	Quality of life for elderly people	Survey

Green bike lane and its related actions has the fundamental characteristic of favouring connectivity between city West and East. Accessibility might be measured as distance or time of urban green spaces for population.

Comprehensive Urban, Sustainable and Safe Mobility Plan for the City of Valladolid (PIMUSSVA) will settle lines of action through which the KPIs will be measured.

*Quality of life for elderly people* and other satisfaction KPIs will be calculated by Surveys developed in the URBAN GreenUP Android mobile application (App), to identify Social perception, wellbeing, etc.

### CHALLENGE 5: Air quality.

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 5:	Environmental	Trends in emissions NOX, SOX	(µg/m3) SO2
	(chemical)		(µg/m3) NO
			(µg/m3) NO2

Smart soils for cycle-pedestrian green paths will be able to capture NOx and SOx, through their properties of atmospheric pollutants capture and inclusion of self-fertilizing properties by transforming these gases into nutrients for the soil. This indicator will be assessed and calculated through data from RCCAVA.

### **CHALLENGE 7: Participatory Planning and Governance**

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 7:	Social	Perceptions of citizens on urban nature -	(%
Participatory		Green spaces quality.	satisfaction)
Planning and			
Governance			

SUDs (VAc8) will contribute in increasing and improving the green spaces within the city. Currently, the percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city which in 2014 was of 68% and 65%, respectively<sup>5</sup>. Valladolid City Council will continuously determine the level of satisfaction regarding the quality and quantity of green spaces in the city so the effect of tree related actions deployment will be quantified.

<sup>&</sup>lt;sup>5</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/





# 4.1.2 Tree related actions and vertical Noise barriers

Interventions Vac3 and Vac4 are grouped as *Tree related actions*, because KPIs selected are the same for the two actions. However, for this deliverable and for keeping the sub-demos structure, these two actions have been separated.

The same situation is applied to Vac22 and Vac23 as *Green noise barriers*.

## Current status of the area



The Parks and Gardens Municipal Service of Valladolid City Council provides general maintenance services of green areas, maintenance of the tree-lined road, and conservation of urban furniture, fountains and children's games.

Valladolid has an Action Plan against Noise. The Ministry of Environment and Rural and Marine Affairs calculated the Noise

Strategic Maps of the city of Valladolid, whose data can be consulted in the Basic Information System on Acoustic Pollution (SICA)<sup>6</sup>.

### **NBS** description

VAc2- Planting	Plantation of 1,000 trees along the Green Corridor area to provide shady places and to improve the user's well-being.			
1,000 trees	Trees series will hold the connectivity among spaces and will contribute to preserve biodiversity. All actions related to tree planting will contribute also to carbon sequestration. It will be considered allergic issues (thus no-allergy species ( <i>Magnolia grandiflora, Celtis australis,</i> etc.) and female trees (dioecius) will be planted. Tree pits design will include water runoff harvesting systems to minimize the irrigation.			
VAc3-Tree shady places (500 trees)	Plantation of 500 trees in leisure area next to Football Stadium it will generate an arboreal shady place. This area will cover 3,000 m <sup>2</sup> to generate natural woodland which will provide humidity, and to preserve the local biodiversity in the funfair area.			
VAc22- Green noise barriers	Green noise barriers in order to avoid the noise effects in urban areas. It is foreseen to install 3 units along the Valladolid Urban Green Corridor. Green Noise Barriers (VAc22 and VAc23) include innovative substrate and specific vegetal species in order to avoid negative effect of traffic noise with a minimum maintenance (guarantying their sustainability). It is taken into			

minimum maintenance (guarantying their sustainability). It is taken into account the use of anti-allergy plant.

Table 4.2: NBS of Sub-Demo A "Tree related action"

<sup>&</sup>lt;sup>6</sup> SICA <u>http://sicaweb.cedex.es/</u>





### Baseline calculation of the area

The implementation of NBSs VAc2 and VAc3 will account for several impacts regarding the environmental and social challenges established in EKLIPSE.

Interventions Vac22 and Vac23 are grouped as *Green noise barriers*, because KPIs selected are the same for the two actions. However, for this deliverable and for keeping the sub-demos structure, these two actions have been separated (See also *4.2.1 Vertical Green Interventions*).

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
	Carbon savings	Tonnes of carbon removed or stored per	(ton CO <sub>2</sub> /Ha)
	per unit area	unit area per unit time (ton CO <sub>2</sub> /Ha) (ton	(ton
	Carbon storage	CO <sub>2</sub> /year).	CO <sub>2</sub> /year)
CHALLENGE 1:	and	Total amount of carbon stored in	
Climate	sequestration	vegetation (ton)	
mitigation &	Temperature	Decrease in mean or peak daytime local	(°C)
adaptation	reduction	temperatures (°C)	
	(environmental	Heatwave risks (number of combined	(nº days)
	(environmental,	tropical nights (>20 °C) and hot days (>35	
	physical)	°C)	

#### CHALLENGE 1: Climate mitigation & adaptation.

This indicator, related to the Climate Change mitigation, will be calculated using a methodology that has yet to be defined completely. There are several possibilities to do that but to make the initial calculations of the expected impact we used the *Guide to estimate carbon dioxide absorptions*<sup>7</sup> (in Spanish) from the Spanish Office of Climate Change edited by the Spanish Ministry of Agriculture, Alimentation and Environment.

After defining the proper methodology to be used (it will be studied in coming months and discussed among all demo partners in the project), collection data about users and uses during the project will be carried out before and after the implementation.

For the calculation of the baseline for this intervention, it will be used the census of trees of the city for the selected areas.

The deployment of *Tree related areas* generate natural Carbon sinks within the city and the subsequent reduction of city's carbon footprint. The methodology to calculate the carbon dioxide absorption is summarized in a guide elaborated by the Spanish Ministry of Agriculture, Food and Environment (MAPAMA). Furthermore, in project proposal, a sequestration of 29.18 tCO<sub>2</sub> eq/year, due to the deployment of actions VAc2, VAc 3, VAc 4 and VAc 5, is estimated. Also according to the proposal, VAc 7 would promote the sequestration of 16.5 tCO<sub>2</sub> eq/year.

The introduction within the city centre of *Tree shady places* and trees in general, will result in a reduction of the urban temperature, both in terms of the decrease in mean or peak daytime temperatures, but also in the reduction of heatwave risks.

 $<sup>\</sup>label{eq:product} ^{n} http://www.mapama.gob.es/es/cambio-climatico/temas/mitigacion-politicas-y-medidas/guia_huella_carbono_tcm7-379901.pdf$ 





- As stated in the project proposal, a reduction between 2 °C and 4 °C is estimated as a consequence of the NBS planed in actions VAc2, VAc3, VAc4 and VAc5.
- Also a reduction of 2°C is estimated to result from Vac7.

The Spanish State Agency of Meteorology provides Valladolid temperatures records from May 2013<sup>8</sup>. However, there is no temperature data from the specific places where the tree related actions will be located and in which the reduction of the temperature will be more evident.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 2: Water	Physical indicators	Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)
Management		Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)
		Areas (Ha) and population (inhab) exposed to flooding	(Ha) (inhab)
		Flood peak reduction. Increase in time to peak (%).	(%)
		Reduction of drought risk (probability).	
		Intercepted rainfall	(m3 year-1)
		Share of green areas in zones in danger of floods (%)	(%)
		Population exposed to flood risk (% per unit area)	(%/m2)
	Chemical	Nutrient abatement, abatement of	(COD (mg/l);
	indicators	pollutants (%, nutrient load, heavy	Biochemical BOD
		metals)	(mg/l); SST (mg/l)
		Water for irrigations purposes (m <sup>3</sup> ha- 1year-1)	(m³/ha/year)

#### CHALLENGE 2: Water Management.

At this phase we believe to complete: Run-off coefficient in relation to precipitation quantities (mm/%); Absorption capacity of green surfaces, bioretention structures and single trees ( $m_3/m^2$ ;  $m^3$ /tree); and Intercepted rainfall ( $m^3$ /year). But other Water Management KPIs will be considered.

The implementation of tree based NBS within the city has a notable impact in terms of precipitation retention as a consequence of the run-off coefficient reduction. The action to plant a single tree in a previously asphalted area changes this area run-off coefficient from 0.6 to 0.25 approximately<sup>9</sup>. Tree related actions (VAc2, VAc3, VAc4, VAc5 and VAc7) are linked to the introduction of 33,100 m<sup>2</sup> of drainage surfaces. According to Valladolid annual precipitation (480

<sup>&</sup>lt;sup>9</sup> Armson, D., Stringer, P., & Ennos, A. R. (2013). The effect of street trees and amenity grass on urban surface water runoff in Manchester, UK. *Urban Forestry and Urban Greening*, *12*(3), 282–286.





<sup>&</sup>lt;sup>8</sup> Meteorology State Agency. Agencia Estatal de Meteorología. Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente. Available at: http://www.aemet.es/es/portada https://datosclima.es/Aemet2013/Precipitastad2013.php

 $mm/m^2/year$  in 2016)<sup>10</sup> and the increase in drainage surfaces, a biorretention of 150  $I/m^2$  is expected.

Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 4: Green Space Management	Social indicators (benefits)	Accessibility (measured as distance or time) of urban green spaces for population	(m) (min)
		Weighted recreation opportunities provided by Urban Green Infrastructure.	(nº)
		Distribution of public green space – total surface or per capita.	(m2/capita)
	Environmental	Pollinator species increase (number)	(nº) (%)
	(biological)	Increased connectivity to existing GI: - Km or Ha connected trees.	(km or Ha)
		Sustainability of green areas	(Not defined yet)
		Quality of life for elderly people	Survey

#### **CHALLENGE 4: Green Space Management**

In 2014, 96% of the population in Valladolid lived at a lower distance of 500 m from a green space of, at least, 5000 m<sup>2</sup>11. Valladolid City Council will continuously determine the accessibility to green spaces so the effect of URBAN GreenUP can be quantified.

Although there no public data was found regarding the Weighted Recreation Opportunities, Valladolid City Council, in the context of the project, will quantify this type of activities in the frame of URBAN GreenUP project.

Related to *Distribution of public green space*, current figures of green space distribution in the city of Valladolid are of 16.7m<sup>2</sup>/capita<sup>12</sup>. The expected introduction of 33,100 m<sup>2</sup> of green surface in the context of the tree related actions will result in an increase of 0.1 m<sup>2</sup>/capita of green space.

Among other factors, the *Sustainability of green areas* is subjected to the municipal budged inverted in them. In 2014 Valladolid city council spent a 43% of the municipal budged in sustainable development policies<sup>13</sup> what points out their intention to work for the sustainability of the green areas in terms of budged prioritization. The deployment of the URBAN GreenUP project will significantly contribute to the urban green space increase and therefore to the

<sup>13</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/





<sup>&</sup>lt;sup>10</sup> Meteorology State Agency. Agencia Estatal de Meteorología. Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente. Available at: http://www.aemet.es/es/portada; https://datosclima.es/Aemet2013/Precipitastad2013.php

<sup>&</sup>lt;sup>11</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/

<sup>&</sup>lt;sup>12</sup> Valladolid City Council (2017) Surface of green areas. Available at: http://www.valladolidencifras.es/

overall sustainability of the city. Further than budged ( $\in$ ), other quantification units shall be considered for this KPI.

Finally, although no data is available to quantify the current quality of life for elderly people the URBAN GreenUP project contemplates the development of surveys by means of the URBAN GreenUP Android mobile application (App). These surveys will aim at identifying social perception and wellbeing in population by means of satisfaction measures. As a result of these surveys campaign, at the end of the project there will be data to quantify its incidence in terms of quality of life for elderly people.

Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 5: Air Quality	Environmental (chemical)	Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted)	(μg/m <sup>3</sup> ) PM <sub>2.5</sub> (μg/m <sup>3</sup> ) PM <sub>10</sub>
		Trends in emissions SOX	(µg/m³) SO <sub>2</sub>
		Trends in emissions NOX	(μg/m³) NO (μg/m³) NO2
		Trends in emissions CO	(mg/m³)
		Annual mean levels of Benzene C <sub>6</sub> H <sub>6</sub>	μg/m³
		Concentration of formaldehyde in air.	ppm
		Annual mean levels Xylene $C_6H_4$ (CH <sub>3</sub> ) <sub>2</sub>	μg/m³
		Quality air index (ICA)	ICA
	Economic	Monetary values	(€)

### CHALLENGE 5: Air quality

The Valladolid City Council Air Pollution Control Network (RCCAVA) measures air quality at 5 different stations spread through the city (PM10 $\rightarrow$  17 µg/m<sup>3</sup> (2016); PM2,5 $\rightarrow$  15 µg/m<sup>3</sup>; SO<sub>2</sub>  $\rightarrow$  Maximum value year 2016: 34 µg/m<sup>3</sup>; NO<sub>2</sub>  $\rightarrow$  Maximum value per hour, year 2016: 191 µg/m<sup>3</sup>; CO  $\rightarrow$  Maximum value per hour, year 2016: 2 mg/m<sup>3</sup>; C6H6 $\rightarrow$  annual mean levels 2016: 0.3µg/m<sup>3</sup>) <sup>14</sup>. These measures will serve as the baseline to quantify the improvement of air quality as a consequence of NBS implementation. RCCAVA will continuously measure air quality all along the project so the effect of URBAN GreenUP will be quantified.

Other target contaminants will be considered within the URBAN GreenUP project context: formaldehyde and Xylene  $C_6H_4$  (CH3). The installation of sensors for monitoring the later contaminants is considered within the project.

One of the outputs of the URBAN GreenUP project, included in the WP7 – Exploitation and Market deployment, is the "Ex ante and Ex post monetary evaluation of the cost and benefits associated with the NBS in the demo sites using the ESA sites". The evaluation of the KPI *Air Monetary values* ( $\in$ ), will be deeply developed within this WP for all the interventions planned within the Project.

<sup>&</sup>lt;sup>14</sup> Valladolid City Council Air Pollution Control Network (RCCAVA) (2017) Available at: www.valladolid.es/es/rccava/datos-red/datosactualizados-temporales





Monetary values will be measured in terms of value of air pollution reduction; total monetary value of urban forests including air quality, run-off mitigation, energy savings, and increase in property values.

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 7:	Social	Perceptions of citizens on urban nature -	(%
Participatory		Green spaces quality.	satisfaction)
Governance		Openness of participatory processes.	(nº processes)
			(population)

**CHALLENGE 7: Participatory Planning and Governance** 

*Tree related actions* will contribute in increasing and improving the green spaces within the city. Currently, the percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city which in 2014 was of 68% and 65%, respectively<sup>15</sup>. Valladolid City Council will continuously determine the level of satisfaction regarding the quality and quantity of green spaces in the city so the effect of tree related actions deployment will be quantified.

Valladolid has many participatory processes to get the citizens opinions. According to Valladolid City Council, currently there are 7 opened participatory processes<sup>16</sup> which include all people above 16 years old. In the context of URBAN GreenUP project participatory initiatives through social networks will be addressed to engage an online community and enhance public understanding of the NBS introduced. According to the strategy of the project, *Tree related actions* might constitute a base to engage citizens into decision processes about tree species used or garden configurations considered (i.e.).

## **CHALLENGE 9: Public Health and Well-being**

This challenge is related directly with the sound green barriers. This type of intervention seeks to reduce the noise level along the green corridor.

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 9: Public Health and Well-being	Psychological indicators	Noise reduction rates	dB(A)
	Health indicators	Increase in walking and cycling in and around areas of interventions.	(nº users)

Currently, we can find this information in <u>Valladolid City Council Air Pollution Control Network</u> (RCCAVA). The levels on 2016 were:  $L_d$ : 59,9 dB(A);  $L_e$ : 59,8 dB(A);  $L_n$ : 51,3 dB(A);  $L_{den}$ :61,0 dB(A)

The Municipal Plan against Noise Pollution of Valladolid shows noise levels in Valladolid and population exposed to traffic noise.

<sup>&</sup>lt;sup>16</sup> Valladolid City Council (2017) Available at: www.valladolid.es





<sup>&</sup>lt;sup>15</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/

Noise Level (dBA)	Population	
55-59	372	
60-64	441	
65-69	298	
70-74	87	
>75	1	

LDEN

dB (A)	Población	Viviendas	%	Distribución de la pob expuesta
< 55	2011	1287	62,66	8 YON 2,70% -0.02%
55 - 60	372	238	11,58	
60 - 65	441	282	13,73	11,12%
65 - 70	298	191	9,3	
70 - 75	87	56	2,7	11,28%
> 75	1	1	0.03	ELINS.

Tabla 9. Población (en centenas) y viviendas expuestas al ruido de tráfico rodado.

Table 4.3: Population (in hundreds) exposed to traffic noise in Lden (Source: Municipal Plan againstNoise Pollution of Valladolid)

The introduction of *Tree related areas* and other actions will also Increase the number of citizen biking and walking around areas of intervention. Although there is no data of the number of walkers and bikers in the specific locations of the interventions, the baseline of Valladolid would be that in 2014 the 53% of the people mainly moves through the city walking or by bicycle as the first option<sup>17</sup>. The City Council will continue quantifying the type of transport used by Valladolid citizens so the effect of the project implementation can be quantified<sup>18</sup>. According to the proposal, it is estimated that than 200,000 citizens per year will use this transports through tree related zones.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 10: Potential of	Economic	New businesses attracted and additional business rates (Eftec, 2013).	(business)
opportunities		Number of jobs created; gross value added.	(jobs) (GDP)

*Tree related actions* deployment improve urban area sustainability and beauty. As a consequence, businesses are attracted to the areas in which the green predominates. Accordingly, the effect of VAc2, VAc3, VAc4, and VAc7 will be quantified by the City Council once all NBS are implemented. The number of businesses in the city as function of the economic

<sup>&</sup>lt;sup>18</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/





<sup>&</sup>lt;sup>17</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/

sector to which they belong<sup>19</sup> published by the Valladolid City Council will serve as a baseline to determine the positive effects of URBAN GreenUP.

No public data was found about current number of people working in Parks and Gardens Department. However, the creation of new jobs due to the construction, operation and maintenance of VAc2, VAc3, VAc4, VAc5 and VAc7 will be quantified at the end of the project.

### 4.1.3 Natural pollinator's modules

### Current status of the area

Current existence of pollinator's modules in the city of Valladolid is unknown.

#### **NBS** description

VAc19- Natural	Installation of water fountain, housing facility for pollinators and birds, bushes and aromatics species in natural ground.
pollinator's modules	6 units of VAc19 will be designed and installed. Each pollinator module of 6 m <sup>2</sup> will be installed in the ground with Smart Soil (VAc16) and it will include a water fountain, housing facility for pollinators and birds, bushes and aromatics species. It will have special attention to install anti-allergy species ( <i>Lavandula latifolia</i> , <i>Rosmarinus officinalis</i> , <i>Salvia lavandulifolia</i> , etc.).

Table 4.4: NBS of Sub-Demo A "Pollinator's modules"

### Baseline calculation of the area

Currently in the city, there are no pollinator modules as such. However, all over the city are green areas with some of the characteristics of the pollinator modules, more specifically the natural pollinator's modules.

We have initially selected three indicators to assess the impact of this solution. These indicators will provide information on biodiversity both at the city level and at the level of each of the modules that are installed.

**CHALLENGE 4: Green Space Management** 

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 4:	Environmental	Increased connectivity to existing GI	(m) (%)
Management	(blological)	Pollinator species increase (number)	(nº) (%)
		Perceptions of connectivity and mobility	Survey

*Increased connectivity to existing GI* is a high-level indicator and it will measure the connectivity among the green areas in the city. The methodology for calculating it is not established but there are references in other projects at European level which are working to create a common

<sup>&</sup>lt;sup>19</sup> Valladolid City Council (2017) Enterprises per economic sector. Available at: http://www.valladolidencifras.es/





framework like MAES<sup>20</sup>. URBAN GreenUP will adopt the methodology selected and will determine the baseline.

*Perception of connectivity and mobility* is also a high-level indicator and it will measure the citizen perception about connectivity of green areas and mobility, both of citizens and biodiversity.

On the other hand, we have selected an additional indicator about *Pollinator species increase*. There are no studies on biodiversity in the city of Valladolid or on the type or quantity of pollinators in the city. So, we have selected a specific indicator to identify and quantify pollinators in the interventions area: *Pollinator species increase (number)*. Procedure and methodology will be defined in the forthcoming months and baseline of the areas of interventions will be established.

In the areas of intervention planned for the natural pollinator's modules there will be a certain presence of pollinators that will be defined before carrying out the interventions.

# 4.2 Subdemo B

Downtown and some city districts suffer heat island effect, poor air quality and noise. This affects social and economic activity, affecting the health of citizens and increases energy demand dramatically in summer times.

Sub-Demo B includes some Green Infrastructures (GI) that will reduce maximum/averages temperatures, will increase relative humidity and will reduce air pollutants. In this zone, it will be used NBS adapted to high-urbanized areas. Sub-Demo B provides evidences of positive impacts of GI to facilitate the GI embedding in municipality/commercial planning decisions.

**Sub-Demo B "City centre - NBS to reduce heat island effect and improve Air Quality"** is divided into the following sub-zones:

- a) Vertical green interventions.
- b) Horizontal green interventions.
- c) Electro wetland.
- d) Urban garden bio-filter.
- e) Tree related actions.
- f) Compacted pollinator's modules and smart soils.

## 4.2.1 Vertical Green Interventions

Interventions Vac22 and Vac23 are grouped as *Green noise barriers*, because KPIs selected are the same for the two actions. However, for this deliverable and for keeping the sub-demos structure, these two actions have been separated.

<sup>&</sup>lt;sup>20</sup> https://biodiversity.europa.eu/maes/





## Current status of the area

The existence of current Vertical Green Interventions in the city of Valladolid is unknown.

NBS descripti	on
---------------	----

Façade

VAc23- Green noise barriers	Green noise barriers in order to avoid the noise effects in urban areas. There will be installed 15 units in streets from the city centre. These structures will be designed to allow passage of wind, thus avoiding its fall and it will mobile characteristics. VAc22 and VAc23 include innovative substrate and specific vegetal species in order to avoid negative effect of traffic noise with a minimum maintenance (guarantying their sustainability). It is taken into account the use of anti-allergy plant.
VAc24- Green Vertical mobile garden	Installation of mobile gardens in urban areas of the city centre. It will be installed 13 units in units in streets from the city centre. These GI will be designed and installed in order to streets re-naturing and preserve and enhance the urban biodiversity. These GI will be mobile, and include innovative substrate and specific plants guarantee their sustainability with a minimum maintenance. It is taken into account the use of anti-allergy plant.
VAc25- Green	Installation of a green façade.

It is foreseen to install a green façade with 1,400 m<sup>2</sup> in a building of the city centre. This innovative GI is a modular system of green façade with low costs and low maintenance (due to the use of a smart specific substrate and a saving water system) and could content plants which can resist hard conditions (frost and drought). It is taken into account the use of anti-allergy species.

Table 4.5: NBS of Sub-Demo B "Vertical green interventions"

### Baseline calculation of the area

With these three NBS the URBAN GreenUP project wants to achieve the following challenges.

Interventions Vac22 and Vac23 are grouped as *Green noise barriers*, because KPIs selected are the same for the two actions. However, for this deliverable and for keeping the sub-demos structure, these two actions have been separated. For Noise barriers, see *4.1.2 Tree related actions and vertical Noise barriers*.

### CHALLENGE 1: Climate mitigation & adaptation.

In this section the main objective is to reduce the local temperatures. There are two KPI that should be monitored to study the results in this challenge.





Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 1:	Temperature reduction	Decrease in mean or peak daytime local temperatures (°C)	(°C)
mitigation & adaptation	(environmental, physical)	Heatwave risks (number of combined tropical nights (>20 °C) and hot days (>35 °C)	(nº days)

Decrease in mean and peak daytime local temperatures (°C) is a city and local level indicator and it will measure the reduction in mean and peak daytime local temperatures. This is a City indicator because there is data available from different meteorological stations in the city; and it is also a Local indicator because in the URBAN GreenUP project, we will use a local network of temperature and relative humidity sensors to assess the impact (and defined the baseline) in the specific areas of intervention. The methodology for calculating it is not established but there are references that are being discussing at NBS European projects level in Task force groups promoted by EASME and EU Commission. URBAN GreenUP will adopt the methodology selected and will determine the baseline.

Regarding the *Heatwave risks* indicator, we can make the same comments than for the previous one, both in scale of evaluation and the process to select the methodology.

Currently, we can consult this information in the <u>Spanish State Meteorological Agency</u>. In this web site there are different lists with the temperatures of all the Spanish cities from May 2013. During the URBAN GreenUP project we would use this information to monitoring temperatures in Valladolid.



Figure 4.3: Historic temperature in Valladolid since 2015 (Source: AEMET)

Value	Temperature ( °C)	Date
Highest High Temperature Registered:	39.2	29-06-2015
Lowest Maximum Temperature Registered:	-0.1	06-01-2015
Highest Temperature Registered:	22.6	24-08-2016
Lowest temperature registered:	-6.6	31-12-2016

Table 4.6: Maximum and minimum temperatures





#### CHALLENGE 4: Green Space Management

The vertical garden interventions, could contribute to increase the quantity of animals, mainly, birds and insects. With these interventions we provide of new green areas where they can life. The pollinators are one of the most important species to the balance of the ecosystems, for this reason is important to monitoring the quantity of these animals:

Eklipse	Type of	KPI Definition	KPI Unit
Challenge	indicator		
CHALLENGE 4:	Environmental	Pollinator species increase (number)	(nº) (%)
Green Space	(biological)		
Management	Social	Accessibility (measured as distance or	
	indicators	time) of urban green spaces for	(m) (min)
	(benefits)	population.	
		Distribution of public green space –	(m2/conito)
		total surface or per capita.	(mz/capita)

*Pollinator species increase*. Actually we don't have any information about how many pollinators there are in the city of Valladolid, but this must be monitored during the project.

Accessibility. This is a high-level indicator (coming from SDG<sup>21</sup>) and it will measure the accessibility for citizens to the urban green spaces in the city. The methodology for calculating it is not established but there are references that are being discussing at NBS European projects level in Task force groups promoted by EASME and EU Commission. URBAN GreenUP will adopt the methodology selected and will determine the baseline.

*Distribution of public green space – total surface or per capita*. Regarding this indicator, we can make the same comments than for the previous one, both in scale of evaluation and the process to select the methodology.

#### CHALLENGE 5: Air quality

With these types of interventions, we expect to improve the air quality near the green vertical interventions. For this reason, we would like to monitor the following aspects:

Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 5: Air Quality	Environmental (chemical)	Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted) concentration recorded µg/m3	(μg/m <sup>3</sup> ) PM <sub>2.5</sub> (μg/m <sup>3</sup> ) PM <sub>10</sub>
		Trends in emissions SOX	(µg/m³) SO <sub>2</sub>
		Trends in emissions NOX	(μg/m³) NO (μg/m³) NO <sub>2</sub>
		Trends in emissions CO	(mg/m³)
		Annual mean levels of Benzene C <sub>6</sub> H <sub>6</sub>	µg/m³
		Concentration of formaldehyde in air.	ppm
		Annual mean levels of Xylene $C_6H_4$ (CH <sub>3</sub> ) <sub>2</sub>	μg/m³

<sup>21</sup> http://www.un.org/sustainabledevelopment/sustainable-development-goals/





This information could be consulted in the <u>Valladolid City Council Air Pollution Control Network</u> (<u>RCCAVA</u>). Currently, we have information from 2016 of this emissions, and contaminants:

- PM<sub>10</sub>: 17 μg/m<sup>3</sup>
- PM<sub>2,5</sub>: 15 μg/m<sup>3</sup>
- Maximum value SO<sub>2</sub>: 34 μg/m<sup>3</sup>
- NO<sub>2</sub> Maximum value per hour: 191 μg/m<sup>3</sup>
- CO Maximum value per hour: 2 mg/m<sup>3</sup>
- e Benzene C<sub>6</sub>H<sub>6</sub>: 0.3µg/m<sup>3</sup>

Figure 4.4: Web of the Valladolid City Council Air Pollution Control Network (RCCAVA)

From URBAN GreenUP, we think that it would be necessary to monitoring these two KPIs too. Currently we don't have any information about them. To control these emissions, we need a specific installation of monitoring sensors.

- Concentration of formaldehyde in air, measured in ppm.
- Annual mean levels of Xylene  $C_6H_4$  (CH<sup>3</sup>)<sub>2</sub>, measured in  $\mu g/m^3$ .

### **CHALLENGE 6: Urban Regeneration**

We would like to know which the positive effects in the urban regeneration are when a Vertical Green infrastructure is built in the city. For this reason, we are going to control de next parameters:

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 6: Urban	Socio- cultural	Savings in energy use due to improved GI.	(kWh/m²)
Regeneration	indicators	Assessment of typology, functionality and benefits provided pre and post interventions.	(m²/capita)

In Valladolid, (like in the rest of Spain) the buildings that has been built before 1980, does not obey any thermal insulation conditions for this reason they need any energy rehabilitation <sup>22</sup>.

	Num. of	Num. housing	% of housing	% of housing
	housing <1950	1950-80	<1950	1950-80
Total	7,399	90,784	5%	66%

Table 4.7: Houses built before 1890

 $<sup>^{\</sup>rm 22}$  Review of the General Plan of Urban Planning of Valladolid. Informative Memory. Volume II. Title XI





One of the KPI that is necessary to study is the *Savings in energy use due to improved GI*. When a green infrastructure is installed in the envelope of a building, it usually brings greater isolation. We could study this KPI easily, with an electricity meter to measure the expenses in air conditioning and heating.

Another indicator of urban regeneration is the *increase of green surfaces*. All the new green structures will be counted as new green surfaces.

#### **CHALLENGE 10: Potential of economic opportunities**

The creation of new urban green infrastructures attracts citizens to the area. This movement of citizens is generally exploited by merchants, which causes an increase in business.

On the other hand, these green infrastructures must be maintained. This situation generates an increase in the job offers of gardening work. For this reason, we would like to monitor the following aspects:

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 10: Potential of	Economic	New businesses attracted and additional business rates (Eftec, 2013).	(business)
opportunities		Number of jobs created; gross value added.	(jobs) (GDP)

This information can be offered by the Opening License Department and by the Parks and Gardens Department, both from the city council.

## 4.2.2 Horizontal Green Interventions

### Current status of the area

The existence of current Horizontal Green Interventions in the city of Valladolid is unknown.

### **NBS** description

VAc27-	Green shelter to provide shadow coverage and fight against HIE.
Green Covering Shelter	To fight against HIE it is foreseen to install 2 units of this GI in España Sq. zone (in 2 existing covering shelter), which integrate specific vegetation in a curve surface with a minimum maintenance. The used of local and anti-allergy species will be taken into account. Each covering shelter will provide 450 m <sup>2</sup> of green surface. Additionally, it might be installed 2 bus shelters in Zorrilla Sq. zone (8 m <sup>2</sup> each).

**VAc28-** *GI* installed in a roof in order to provide water for plants, humidity for the air and to capture CO<sub>2</sub>.

1 unit of Green Roof will be installed in the vegetation" growing medium- Campillo Market building to connect this area filter membrane drainage layer with España Sq. This vegetal roof integrates root barrier . vegetation specific with а minimum waterproofing maintenance and anti-allergy properties. Its membrane . structural features provide water for plants, humidity for the air and may



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capture  $CO_2$ . Likewise, the green roof contributes to reduce the energy consumption due to the improvement of isolation.

VAc29-Green structures to provide shadow coverage with minimum maintenance. Green

It is foreseen the installation of 11 green shady structures, which incorporate the space to plantation of fast-growing creepers and climbing plants (adapted to climate conditions) It will be necessary the use of perennial deciduous species, which allow pass the sun light in

wintertime. Each GI will provide 4 m2 of shady surface.

Table 4.8: NBS of Sub-Demo B "Horizontal green interventions"

## Baseline calculation of the area

Baseline calculation of Horizontal Green Interventions (4.2.2) is very similar to the baseline calculation of Vertical Green Interventions (See 4.2.1). The only difference between them is that in the Horizontal Green Interventions we do not pursue the CHALLENGE 9: Public Health and Well-being, but we want to achieve CHALLENGE 2: Water Management.

#### **CHALLENGE 2: Water Management.**

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 2: Water	Physical indicators	Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)
Management	Chemical indicators	Water for irrigations purposes (m <sup>3</sup> ha- 1year-1)	(m³/ha/year)

On the one hand, the NBS Green Covering Shelter and Green Roof have the capacity to retain rain water, reducing the number of litres to evacuate at the moment when precipitation is occurring. The storage capacity depends on the design of the cover, but in all cases, the existence of these constructive solutions means a reduction in the amount of runoff water that the system must assume and a decrease in speed, since water is stored in retainer layers and in substrate. We can prove this capacity with a flowmeter in a drain pipe.

On the other hand, it is good to control how much water is used for irrigations purposes. With a water meter we can control the expenses, and evaluated the benefits.

## 4.2.3 Electro wetland

## Current status of the area

The Electrowetland will constitute a NBS in which wastewater will be treated at the time electricity is produced. The location of the system will preferentially be within a broader green area thus being integrated with the surroundings, although it is still under decision process due to the several municipality areas that are affected by this intervention (Urbanism, Gardening, Water administration, etc.).





**Structures** 

Shady

Currently, urban wastewater generated at Valladolid is treated in the Municipal Treatment Plant (EDAR of Valladolid) by means of a conventional strategy (primary settling, activated sludge processing and secondary settling).

Although constructed at a demo-scale, the introduction of a NWT System in the city centre provides information to the citizenship of other urban wastewater treatment technologies. Furthermore, the conversion of organic matter into electricity by means of the electrowetland is a step further in terms of wastewater treatment innovation techniques.

### NBS description

VAc26-Electro wetland



Electro wetland surface.

Innovative wetland surface, which can provide electricity through microbial fuel cell technology. It requires low construction/installation and low operational costs and can treat different types of wastewaters with different pollutants and loads. This intervention will have 50 m<sup>2</sup>. The system will provide

electricity to feed the irrigation of nearby gardens and illumination.

Table 4.9: NBS of Sub-Demo B "Electro wetland"

## Baseline calculation of the area

The implementation of the Electrowetland has several positive impacts regarding the environmental and social challenges established in EKLIPSE<sup>23</sup>. These challenges are quantified by means of 10 different KPIs.

#### CHALLENGE 1: Climate mitigation & adaptation.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 1: Climate ()	Temperature reduction	Decrease in mean or peak daytime local temperatures (°C)	(°C)

As a green infrastructure the Electrowetland will contribute to a reduction of the peak daytime temperature within the city, which is currently (2015-2017) at 28  $\pm$  8°C (average of monthly maximums)<sup>24</sup>. It is expected a reduction of the temperature in Electrowetland surrounding areas between 1.3 and 2.8 °C which will result in potential cooling energy savings of about 10%<sup>25</sup>.

#### CHALLENGE 2: Water Management.

<sup>&</sup>lt;sup>25</sup> Demuzere, M., Orru, K., Heidrich, O., Olazabal, E., Geneletti, D., Orru, H., ... Faehnle, M. (2014). Mitigating and adapting to climate change: Multi-functional and multi-scale assessment of green urban infrastructure. *Journal of Environmental Management*, 146, 107–115.





<sup>&</sup>lt;sup>23</sup> Raymond, C.M., Berry, P., Breil, M., Nita, M.R., Kabisch, N., de Bel, M., Enzi, V., Frantzeskaki, N., Geneletti, D., Cardinaletti, M., Lovinger, L., Basnou, C., Monteiro, A., Robrecht, H., Sgrigna, G., Munari, L. and Calfapietra, C. (2017) An Impact Evaluation Framework to Support Planning and Evaluation of Nature-based Solutions Projects. Report prepared by the EKLIPSE Expert Working Group on Nature-based Solutions to Promote Climate Resilience in Urban Areas. Centre for Ecology & Hydrology, Wallingford, United Kingdom

<sup>&</sup>lt;sup>24</sup> Meteorology State Agency. Agencia Estatal de Meteorología. Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente. Available at: http://www.aemet.es/es/portada

Eklipse	Type of	KPI Definition	KPI Unit
challenge	Indicator		
CHALLENGE 2:	Physical	Temperature reduction in urban areas	(°C)
Water	indicators		
Management	Chemical	Nutrient abatement, abatement of	Chemical Oxygen
	indicators	pollutants (%, nutrient load, heavy	Demand (COD)
		metals)	(mg/l); Biochemical
		metais).	Oxygen Demand
			(BOD) (mg/l); Total
			Solids (SST) (mg/l)

For "*Temperature reduction in urban areas*" look at "*Decrease in mean of peak daytime local temperature*" (back to Challenge 1).

As a wastewater treatment system the Electrowetland will participate in the removal of organic matter contained in wastewater. As indicated in Ortega et al.  $(2010)^{26}$  removal rates of horizontal subsurface constructed wetlands are of 90-95% for TSS, 90-95% for BOD<sub>5</sub> and 80-90% for COD. Considering wastewater characteristics of Valladolid's urban wastewater (Valladolid treatment plant inflow concentrations (2011-2014): 228 mg/l (BOD<sub>5</sub>) and 240 mg/l (COD))<sup>27</sup>, expected nutrient abatement will be around 200 mg BOD<sub>5</sub>/l and 350 mg COD/l. Electrowetland operation in terms of pollution abatement will be monitored along the URBAN GreenUP project.

### CHALLENGE 4: Green Space Management.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 4:	Social	Accessibility (measured as distance or	(m) (%)
Green Space	indicators	time) of urban green spaces for	
Management	(benefits)	population.	

In 2014, 96% of the population in Valladolid lived at a lower distance of 500 m from a green space of, at least, 5,000 m<sup>2</sup>. Valladolid City council will continuously determine the accessibility to green spaces through Local Agenda 21 indicators, so the effect of URBAN GreenUP can be quantified.

## CHALLENGE 5: Air Quality.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 5: Air Quality	Environmental (chemical)	Trends in emissions NO <sub>x</sub> , SO <sub>x</sub>	(μg/m³) SO2 (μg/m³) NO (μg/m³) NO2

Current figures provided by the Valladolid City Council Air Pollution Control Network (RCCAVA) gives the baseline of this KPI, which can be established at: NO=8  $\mu$ g/m<sup>3</sup>; NO<sub>2</sub>=22  $\mu$ g/m<sup>3</sup>;

<sup>&</sup>lt;sup>27</sup> Aguas de Valladolid (2017) Parámetros de la estación depuradora 2011-2014. Available at: http://www.aguasdevalladolid.com/ESP/180.asp





<sup>&</sup>lt;sup>26</sup> Ortega, E., Ferrer, Y., Salas, J.J., Aragón, C. Real, A (2010) Manual para la implantación de sistemas de depuración en pequeñas poblaciones. Ministerio de Medio Ambiente, Medio Rural y Marino. Available at: http://www.centa.es/portfolio-items/manual-la-implantacion-sistemas-depuracion-pequenas-poblaciones/

 $SO_2=3\mu g/m^3$  (recorded on 20/10/2017 at the Station Arco Ladrillo II)<sup>28</sup>. Emissions of NO<sub>2</sub> in European wetlands were quantified to be between -2.1 and 1000 mg/m<sup>2</sup>/day<sup>29</sup>.

No specific data is available for SOx HSSF emissions.

Expected emission trends after the Electrowetland implementation are difficult to estimate due to the variability of the emission rates. Along the project, the Air Pollution Control Network of the city will continuously measure nitrogen and sulphur emissions.

#### CHALLENGE 6: Urban Regeneration.

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 6:	Urban green	Accessibility: distribution,	
Urban	indicators	configuration, and diversity of green	(% caticfaction)
Regeneration	(environmental,	space and land use changes (multi-	
	biological)	scale) Green spaces quantity	
	Socio-cultural	Savings in energy use due to	(k)(h)
	indicators	improved GI	(KVVII)

Although constructed within an already existing green space, the electrowetland will constitute contribute on the diversity and the configuration of the urban green spaces in Valladolid. The baseline can be defined as the percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city which in 2014 was of 68% and 65%, respectively<sup>30</sup>.

Valladolid City council will continuously determine the level of satisfaction regarding the quality and quantity of green spaces in the city through <u>Local Agenda 21 Indicators</u>, so the effect of URBAN GreenUP can be quantified.

The second main benefit of the electrowetland is the generation of electricity while treating wastewater. Although there is no available data in terms of current produced in systems of the scale of the Demosite in Valladolid we can estimate from smaller experiments that around 0.025 kWh will be produced by the system<sup>31</sup>. Once the Electrowetland will be constructed, the electricity generated will be continuously measured by means of a data-logger installed.

<sup>&</sup>lt;sup>31</sup> Villaseñor, J, Capilla, P, Rodrigo, M.a, Cañizares, P, & Fernández, F J (2013). Operation of a horizontal subsurface flow constructed wetland--microbial fuel cell treating wastewater under different organic loading rates. *Water Research*, *47*(17),6731–8.



<sup>&</sup>lt;sup>28</sup> Valladolid City Council Air Pollution Control Network (RCCAVA) (2017) Available at: www.valladolid.es/es/rccava/datos-red/datosactualizados-temporales

<sup>&</sup>lt;sup>29</sup> Søvik, a K., Augustin, J., Heikkinen, K., Huttunen, J. T., Necki, J. M., Karjalainen, S. M., ... Wachniew, P. (2006). Emission of the greenhouse gases nitrous oxide and methane from constructed wetlands in europe. *Journal of Environmental Quality*, *35*(6), 2360–73.

<sup>&</sup>lt;sup>30</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 7:		Deventions of sitisons on when	
Participatory	Social	Perceptions of citizens on urban	(% satisfaction)
Planning and	500101	nature - Green spaces quality	(// sutisfuction)
Governance			

CHALLENGE 7: Participatory Planning and Governance.

Look at: "Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale). Green spaces quantity" from previous (Challenge 6 Urban Regeneration).

#### CHALLENGE 8: Social Justice and Social Cohesion.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 8: Social Justice and Social Cohesion	Social cohesion	Green intelligence awareness	(nº educ. actions) (inhab attended)

Although there is no data available in terms of the green intelligence awareness of Valladolid citizens, Electrowetland will contribute to its improvement. Educational actions to explain the technology and its benefits to Valladolid's citizens will be developed.

CHALLENGE 10: Potential of economic opportunities and green jobs.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE		Consumption benefits: property	
10: Economic	Economic	betterment and visual amenity	(€)
opportunities		enhancement resulting from NBS.	

As function of the location of the Electrowetland, its impact of the surrounding property betterment and the enhancement of the visual amenity can vary. Accordingly, while if it is located in an already existing green area, no benefits from its implementation in terms of this KPI will be produced. If it is implemented in a non-green space, the housing price can be increased.

Estimations of a positive impact of 20% on property values fronting a passive park are described in bibliography<sup>32</sup>.

Although the location is not defined and therefore there is no specific data regarding the housing prices in the surrounding urban area, the mean value of empty housing prince in Valladolid (2015-2017) was of  $1,239 \notin m^2$  and the last value available from 2017 was of  $1,207 \notin m^2$ .<sup>33</sup>

<sup>&</sup>lt;sup>33</sup> Valladolid City Council (2017) Data of the housing price in Valladolid. Available at: http://www.valladolidencifras.es/





<sup>&</sup>lt;sup>32</sup> Crompton (2005) The impact of parks on property values: empirical evidence from the past two decades in the United States. Managing Leisure 10, 203-218.

## 4.2.4 Urban Garden Bio-Filter

### Current status of the area

The Valladolid City Hall Air Pollution Control Network (<u>RCCAVA</u>) provides measured values of pollutant concentration in the city of Valladolid. RCCAVA issues daily air quality reports<sup>34</sup>.

This 2017 Valladolid has implemented an Action Plan on Atmospheric Pollution<sup>35</sup> with different degrees of alert. Since last July, city centre is closed to traffic on days when there are high levels of pollution (Alert Level).

Urban garden bio-filter is expected to be implemented over the gas grille outlet of an underground parking of Valladolid city centre.

### **NBS** description

 

 VAc30-Urban
 Installation of an urban green bio-filter to treat urban polluted air.

 Garden Bio-Filter
 It will be installed one bio-filter unit in Zorrilla Square zone (10 m<sup>2</sup> in the roof of parking air outlet) using a special substrate (mixture of urban by-products). It will treat urban polluted air (capturing NOx, PM, CO, benzene, toluene, etc.). VAc30 uses rhizodegradation that takes place in soil to purify the polluted

air of an underground parking without waste generation.

Table 4.10: NBS of Sub-Demo B "Urban garden bio-filter"

### Baseline calculation of the area

With the *Urban Garden Biofilter*, URBAN GreenUP project wants to achieve the following Challenge in Valladolid: Air quality.

### **CHALLENGE 5: Air quality**

With these types of interventions, we expect to improve the air quality near to the Garden Bio-Filter intervention. For this reason, we would like to monitor the following aspects:

Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 5: Air Quality	Environmental (chemical)	Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted) concentration recorded ug/m3	(μg/m3) PM2.5 (μg/m3) PM10
		Trends in emissions NOX, SOX	(μg/m3) SO2 (μg/m3) NO (μg/m3) NO2

<sup>&</sup>lt;sup>35</sup> http://www.valladolid.es/es/ciudad/medio-ambiente-salud/noticias/plan-accion-situaciones-alerta-contaminacion



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<sup>&</sup>lt;sup>34</sup> RCAVVA Informes diarios de calidad del aire http://www.valladolid.es/es/rccava/informes-diarios-anuales/informesdiarios-calidad-aire

	Mean levels of exposure to ambient air pollution (population weighted) (proposed indicator for SDG target 3.9)	(inhab) (kg CO2/km car)
Economic	Monetary values	(€)
Social (physiological	Number of deaths from air, water and soil pollution and contamination (proposed indicator for SDG target 3.9)	(nº deaths)
	Air quality parameters NOx, VOC, PM, C6H6, etc. - Quality air index (ICA)	(μg/m3) CO (mg/m3) O3 (μg/m3) C6H6 Quality air index (ICA)

Currently, some of the KPIs like those environmental and social focused on air quality; we can consult into the local monitoring data base sources like: RCCAVA (<u>http://www.valladolid.es/es/rccava/rccava/contaminantes</u>), and Consejería de Sanidad de Castilla y León (<u>https://www.saludcastillayleon.es/es</u>).

In addition to the data available, the URBAN GreenUP project will consider the additional local monitoring data source placed for monitoring of the specific values for biofilter like:

- Mean levels of exposure to ambient air pollution in kg CO2/km car,
- Air quality parameters NOx, VOC, PM etc. in ( $\mu$ g/m3) CO (mg/m3) O<sub>3</sub> ( $\mu$ g/m3) C<sub>6</sub>H<sub>6</sub> Quality air index (ICA)

The expected reduction for those contaminants may be up to 75%, in comparison to the base situation before the bio-filter installation.

## 4.2.5 Tree related action

Interventions Vac3 and Vac4 are grouped as *Tree related actions*, because KPIs selected are the same for the two actions. However, for this deliverable and for keeping the sub-demos structure, these two actions have been separated.

## Current status of the area

See paragraph 4.1.2 Tree related actions and vertical Noise barriers.

## **NBS** description

VAc4-	Shade and cooling trees.
Shade and cooling trees	Plantation of 600 trees in City Centre to increase the urban tree population with shade and cooling purposes.

Table 4.11: NBS of Sub-Demo B "Tree related actions"

## Baseline calculation of the area

See paragraph 4.1.2 Tree related actions and vertical.





# 4.2.6 Compacted Pollinator's Modules and Smart soils

### Current status of the area

There is not pollinator's modules currently installed in the city of Valladolid which have been identified.

### **NBS** description

VAc20-	Mobile window box structures with smart soils, water fountain, housing facility
Compacted	for pollinators and birds, bushes and aromatics species.
Pollinator's	Each module of 4 m2 will have special attention to install antiallergy species
modules	(Lavandula latifolia, Rosmarinus officinalis, Salvia lavandulifolia, etc.).
Vac17- Smarts soils as substrate	Innovative soil with auto-fertilizing and NOX fixing properties. Smarts soils as substrate for green singular infrastructure (SubDemo B). It will be used in SubDemo B in Vac7 and VAc14 (301 m <sup>2</sup> ).

Table 4.12: NBS of Sub-Demo B "Compacted pollinator's modules and Smart soils"

### Baseline calculation of the area

We commented above, for the action VAc19 in section 4.1.3, that currently in the city, there are no pollinator modules as such. This is particularly true for the centre of Valladolid. In this area, there is a lack of green spaces and therefore of natural areas that could serve as support for biodiversity.

#### See section 4.1.3 Natural pollinator's modules.

#### CHALLENGE 2: Water management.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 2: Water Management	Physical indicators	Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)

This indicator is directly related to the infiltration/drainage capacity of soils. It could be assessed at high or at local level for the quantification of run-off coefficient at city or local flood risks reductions. The methodology for calculating it is not established but there are references that are being discussing at NBS European projects level in Task force groups promoted by EASME and EU Commission. URBAN GreenUP will adopt the methodology selected and will determine the baseline.

### CHALLENGE 5: Air quality.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 5: Air Quality	Environmental (chemical)	Trends in emissions NOX, SOX	(μg/m3)





Smart soils for cycle-pedestrian green paths will be able to capture NOx and SOx, through their properties of atmospheric pollutants capture and inclusion of self-fertilizing properties by transforming these gases into nutrients for the soil. This indicator will be assessed and calculated through data from RCCAVA.

# 4.3 Subdemo C

This sub-demo includes a set of actions that will develop sustainable green infrastructures with a high ecological value and model GI with low maintenance costs.

A Natural Wastewater Treatment Plant will be installed inside of an urban park as a model of a source of sustainable water for irrigation.

Additionally, a floodable park at the entrance of Esgueva River in the city will integrate several NBS to minimize flooding risks. Both interventions will provide other co-benefits to Climate Change such as water storage, biodiversity, quality public spaces, health, and wellbeing for citizens. These two interventions also include the installation of several pollinator's modules to promote and enhance biodiversity in the areas.

This SubDemo also include one intervention to develop a new concept of car parking area in the city by installing green pavements with high drainage capacity, planting tree to provide shadow space and reduce temperature of pavement and cars, creating SUDs and rain gardens to capture water runoff of annexes asphalt areas.

On the other hand, all of this intervention will have smart soils to enhance soil performance regarding drainage capacity and pollutants capture.

Sub-Demo C "Retrofit urban ecosystems to improve well-being and to avoid flood risk. New models of re-naturing urban areas" is divided into the following sub-zones:

- a) Renaturing parking area.
- b) Sustainable urban park.
- c) Floodable park.
- d) Natural pollinator's modules.
- e) Urban farming.

## 4.3.1 Re-naturing parking area

### Current status of the area

José Zorrilla Football Stadium has more than 2,500 parking places for cars and coaches. In proximity there is another concrete esplanade that is used yearly for the funfair, and for weekly market, among other municipal uses. The area does not have high tree density or shade zones.





VAc14- Green Parking Pavements	Green pavements with 50% vegetal soil and high drainage capacity.         2,000 m² of asphalt pavement will be substituted by green pavements in the Zorrilla Football Stadium parking area. VAc14 will have gaps, which will be filled with smart soil and with specific creeping grass species with a short growing and minimum maintenance.
VAc5-Re- naturing	Plantation of 250 trees in the facilities of parking area. It is foreseen to plant 250 trees in the facilities of Football Stadium. This action
parking trees	involves the development of a new concept of car parking in combination with VAc9 and VAc14 actions.
VAc9-SUDs	SUDs for managing and treating surface water runoff in parking area.
for re- naturing parking	In order to contribute to re-naturing parking areas it is foreseen the installation of 3 SUDs (50 m <sup>2</sup> each) in the parking of Football Stadium Zone.
VAc10-Rain	Rain gardens to complete the managing and treating surface water runoff
gardens	1.000 m2 of rain gardens will be installed in the parking of Football Stadium zone. This kind of gardens contributes to preserve the habitat value and diversity for local ecological communities. Native and adapted plants, more tolerant to local conditions will be used. These have deep and variable root systems for enhanced water infiltration and drought tolerance.
VAc18-	Innovative soil with auto-fertilizing and NOX fixing properties.
Smarts soils as substrate	Smarts soils as substrate for green singular infrastructure (SubDemo B). It will be used in SubDemo B in Vac7 and VAc14 (301 m <sup>2</sup> ).

## **NBS** description

Table 4.13: NBS of Sub-Demo C "Football stadium area"

## Baseline calculation of the area

### CHALLENGE 1: Climate mitigation & adaptation.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 1: Climate mitigation & adaptation	Carbon savings per unit area Carbon storage and sequestration	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(ton CO2/Ha) (ton CO2/year)

As we mention in the previous *Tree related actions*, this indicator will be calculated using a methodology that has yet to be defined completely.





### See 4.1.2 Tree related actions and vertical .

### CHALLENGE 2: Water management.

In this section the main objective is to increase the bio-diversity of the urban surface, obtaining better rain water treatment and management, implementing the NBS into the parking areas. In addition, the phenomenon of "heat island" may be reduced, thanks to the temperature reduction in urban areas; effect obtained implementing the NBS as an alternative to the solid and less-absorption capacity pavement.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 2: Water	Physical indicators	Run-off coefficient in relation to precipitation quantities	(mm/%)
Management		Absorption capacity of green surfaces, bioretention structures and trees	(m3/m2) (m3/tree)
		Temperature reduction in urban areas (°C, % of energy reduction for cooling)	(°C, % energy reduction)
	Chemical indic. (water quality)	Water for irrigations purposes	(m3/ha/year)

Absorption capacity indicator is directly related to the infiltration/drainage capacity of soils. It could be assessed at high or at local level for the quantification of run-off coefficient at city or local flood risks reductions. The methodology for calculating it is not established but there are references that are being discussing at NBS European projects level in Task force groups promoted by EASME and EU Commission. URBAN GreenUP will adopt the methodology selected and will determine the baseline.

The useful data indicators are those related to the physical indicators, allowing calculating the absorption capacity in relation to precipitation, like:

- Annual rainfall data,
- Normative values for absorption water by capillarity, floor tiles,

On the other hand, the data allowing the estimation of the % of energy reduction for cooling and urban comfort is needed and existence of the "heat island" effect:

• Annual temperatures.

Additionally, VAc10- Rain gardens will impact on chemical indicators as it is foreseen the reuse of the intercepted and treated water for irrigation purposes. According to the initial figures in URBAN GreenUP proposal, around 67.5 m<sup>3</sup>/year of water will be provided by this unit for water reuse in close green areas.





Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 4:	Social	Accessibility (measured as distance or	(m) (%)
Green Space	indicators	time) of urban green spaces for	
Management	(benefits)	population.	

CHALLENGE 4: Green Space Management.

In 2014, 96% of the population in Valladolid lived at a lower distance of 500 m from a green space of, at least, 5,000 m<sup>2</sup>. Valladolid City council will continuously determine the accessibility to green spaces through Local Agenda 21 indicators, so the effect of URBAN GreenUP can be quantified along the project.

#### CHALLENGE 5: Air quality.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 5: Air quality	Environmental (chemical)	Trends in emissions NOX, SOX	(μg/m3) SO2 (μg/m3) NO (μg/m3) NO2

Smart soils for cycle-pedestrian green paths will be able to capture NOx and SOx, through their properties of atmospheric pollutants capture and inclusion of self-fertilizing properties by transforming these gases into nutrients for the soil. This indicator will be assessed and calculated through data from RCCAVA.

#### CHALLENGE 6: Urban Regeneration.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 6:	Urban green	Accessibility: distribution,	
Urban	indicators	configuration, and diversity of green	(% caticfaction)
Regeneration	(environmental,	space and land use changes (multi-	
	biological)	scale) Green spaces quantity	

SUDs (VAc9) and Rain gardens (VAc10) will impact on Challenge 6: urban regeneration. The baseline can be defined as the percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city which in 2014 was of 68% and 65%, respectively<sup>36</sup>. Valladolid City council will continuously determine the level of satisfaction regarding the quality and quantity of green spaces in the city through <u>Local Agenda 21</u> <u>Indicators</u>, so the effect of URBAN GreenUP can be quantified.

### CHALLENGE 7: Participatory Planning and Governance.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 7: Participatory Planning and Governance	Social	Perceptions of citizens on urban nature - Green spaces quality	(% satisfaction)

<sup>&</sup>lt;sup>36</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/





Look at: "Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale). Green spaces quantity" from previous sections (Challenge 6 Urban Regeneration).

Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 10: Economic opp. and green jobs	Economic	New businesses attracted and additional business rates (Eftec, 2013).	(business)

CHALLENGE TO: FOLEILLIAI OF ECONOMIC OPPOFIUMILES AND GLEEN JODS.
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Actually we don't have any information about the potential business, but this is going to be defined and analysed into the project with help of the exploitation activities and workshops, and having in mind the partners future interest in exploiting products and services.

## 4.3.2 Sustainable Urban Park

## Current status of the area

Currently, the area reserved for the location of the Natural WWTP (VAc13) is a green park and it is not used for wastewater treatment. In fact, there is no any discharge point of wastewaters in that area and the sewage produced by the surrounding population is sewerage and conducted to the centralised WWTP of Valladolid. That means, that VAc13 will suppose the change of the use of part of the park.

## **NBS** description

VAc13- Natural Wastewate r Treatment Plant	Natural plant to treat urban water and irrigate surrounding green areas. Natural Wastewater Treatment Plant (NWTP) will have a surface of 9,000 m2 and it will allow irrigate surrounding green areas. Design is based on Waterharmonica concept. NWTP will be made up by eight vertical SSFW working in parallel and followed by a SFW, which will constitute a network with a positive effect on functionality. The effluent of the wastewater treatment plant will fulfil the requirements for watering urban green areas. VAc13 includes the creation of a surrounding green area of 18,000 m <sup>2</sup> with 500 trees and the park will include VAc21 and VAc34. Park will include a Surface Flow Wetland of 3,200 m <sup>2</sup> will be managed as a self-sufficient ecosystem useful for recreational and social activities.
VAc34- Educational path	<i>Educational path in Wastewater Treatment Plant area.</i> A natural path in order to promote educational activities related to innovative systems in urban surrounding.

Table 4.14: NBS of Sub-Demo C "Sustainable urban park"





### Baseline calculation of the area

#### CHALLENGE 1: Climate mitigation & adaptation.

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
	Carbon savings	Tonnes of carbon removed or stored per	(ton CO2/Ha)
CHALLENGE 1: Climate mitigation & adaptation	per unit area	unit area per unit time (ton CO2/Ha) (ton	(ton
	Carbon storage	CO2/year).	CO2/year)
	and	Total amount of carbon stored in	
	sequestration	vegetation (ton)	
	CO2 og	CO2eq emissions avoided considering a	
	CO2 eq.	life cycle approach and modelling the	(tCO2eq
	Avoidod	environmental impacts regard to	p/year
	Avolueu	indirect savings.	

This indicator, related to the climate change mitigation, will be calculated using a methodology that has yet to be defined completely properly (similar than for the quantification of CO2 emissions from traffic but in this case to calculate emissions avoided by water savings for irrigation purposes). There are several possibilities to do it but to make the initial calculations of the expected impact we used IPCC 2013 GWP 2010a methodology. Considering a life cycle approach and modelling the environmental impacts regard to indirect savings.

After defining the proper methodology to be used (it will be studied in the forthcoming months and discussed among all demo partners in the project), collection data about users and uses during the project will be carried out before and after the implementation.

For the calculation of the baseline for this intervention will be used data collected from water used for irrigation purposes in current and future situations from Valladolid City Council.

As we mention in the previous *Tree related actions, Tonnes of carbon removed or stored per unit area per unit time* indicator will be calculated using a methodology that has yet to be defined completely.

#### See 4.1.2 Tree related actions and vertical .

Type of	KPI Definition	KPI Unit
indicator		
	Absorption capacity of green surfaces,	(m3/m2)
Physical	bioretention structures and single trees.	(m3/tree)
indicators	Reduction of drought risk.	(probability)
	Nutrient abatement, pollutants abatement	COD (mg/l); BOD
	(%, nutrient load, heavy metals): Chemical	(mg/l); SST (mg/l)
Chemical	Oxygen Demand (COD); Biochemical Oxygen	
indicators	Demand (BOD) ; Total Solids (SST)	
	Water for irrigations purposes	(m3/ha/year)
i i	Type of ndicator Physical ndicators Chemical ndicators	Type of ndicatorKPI DefinitionAbsorption capacity of green surfaces, bioretention structures and single trees.Physical ndicatorsAbsorption capacity of green surfaces, bioretention structures and single trees.Reduction of drought risk.Reduction of drought risk.Chemical ndicatorsNutrient abatement, pollutants abatement (%, nutrient load, heavy metals): Chemical Oxygen Demand (COD); Biochemical Oxygen Demand (BOD) ; Total Solids (SST)Water for irrigations purposes

### CHALLENGE 2: Water Management.





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The implementation of a green infrastructure for wastewater treatment and reuse will offer a certain absorption capacity of rainfall, although it may be lower than the observed for other GI, such as SUDs, due to the fact that filtering beds in wetlands are saturated.

The NWTP in VAc13 is designed for both treating the wastewater and the later reuse of the reclaimed water. It is estimated that around 45,000 m<sup>3</sup>/year of reclaimed water for irrigation will be produced, which means the irrigation of about 6.7 ha of green areas. The reuse of reclaimed water for the NWTP will allow address that volume of water for other purposes, that may mitigate the effects of droughts.

Besides, the NWTP will participate in the removal of organic matter contained in wastewater. As indicated in Ortega et al. (2010)<sup>37</sup> removal rates of horizontal subsurface constructed wetlands are of 90-95% for TSS, 90-95% for BOD<sub>5</sub> and 80-90% for COD. Considering wastewater characteristics of Valladolid's urban wastewater (Valladolid treatment plant inflow concentrations (2011-2014): 228 mg/l (BOD<sub>5</sub>) and 240 mg/l (COD))<sup>38</sup>, expected organic matter abatement will be around 200 mg BOD<sub>5</sub>/l and 350 mg COD/l. Moreover, CWs will allow reducing the discharge of nutrients (N and P) and partial removal of pathogens. In order to facilitate the reuse of water a tertiary treatment addressed to disinfection will be implemented, and therefore, pathogens abatement will be noticeably increased. The performance of the NWTP will be monitored along the URBAN GreenUP project.

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
		Accessibility (measured as distance or	(m) (%)
		time) of urban green spaces for	
CHALLENGE 4:	Social	population.	
Green Space	indicators	Distribution of public green space –	(m2/capita) (km
Management	(benefits)	total surface or per capita.	cycle
			lane/capita)
		Pollinator species increase (number)	(nº) (%)

### CHALLENGE 4: Green Space Management.

Three indicators have been selected for monitoring the impact of VAc13 in challenge 4. Two of them are related to the accessibility and distribution of green spaces per capita. In 2014, 96% of the population in Valladolid lived at a lower distance of 500 m from a green space of, at least, 5,000 m<sup>2</sup>. Valladolid City council will continuously determine the accessibility to green spaces through Local Agenda 21 indicators, so the effect of URBAN GreenUP can be quantified along the project.

Besides, the construction of the NWTP will also impact on the pollinator species. This number will be determined according to the common approach adopted by the consortium to measure this KPI.

<sup>&</sup>lt;sup>38</sup> Aguas de Valladolid (2017) Parámetros de la estación depuradora 2011-2014. Available at: http://www.aguasdevalladolid.com/ESP/180.asp





<sup>&</sup>lt;sup>37</sup> Ortega, E., Ferrer, Y., Salas, J.J., Aragón, C. Real, A (2010) Manual para la implantación de sistemas de depuración en pequeñas poblaciones. Ministerio de Medio Ambiente, Medio Rural y Marino. Available at: http://www.centa.es/portfolio-items/manual-la-implantacion-sistemas-depuracion-pequenas-poblaciones/

#### CHALLENGE 5: Air Quality.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 5: Air Quality	Environmental (chemical)	Trends in emissions NOX, SOX	(µg/m3) SO2 (µg/m3) NO (µg/m3) NO2

Current figures provided by the Valladolid City Council Air Pollution Control Network (RCCAVA) gives the baseline of this KPI, which can be established at: NO=8  $\mu$ g/m<sup>3</sup>; NO<sub>2</sub>=22  $\mu$ g/m<sup>3</sup>; SO<sub>2</sub>=3 $\mu$ g/m<sup>3</sup> (recorded on 20/10/2017 at the Station Arco Ladrillo II)<sup>39</sup>. Emissions of NO<sub>2</sub> in European wetlands were quantified to be between -2.1 and 1000 mg/m<sup>2</sup>/day<sup>40</sup>.

No specific data is available for SOx HSSF emissions.

Expected emission trends in the NWTP will depend on the inlet wastewater composition, which will fluctuate seasonally. Therefore, it is difficult to estimate the real emissions of NOX and SOX in VAc13. Along the project, the Air Pollution Control Network of the city will continuously measure nitrogen and sulphur emissions.

#### **CHALLENGE 6: Urban Regeneration.**

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 6: Urban Regeneration	Urban green indicators (environmental,	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-	(% satisfaction)
	biological)	scale) Green spaces quantity	

The NWTP will be located in a actual green area of the city, so the impact on the urban regeneration may be low.

The baseline can be defined as the percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city which in 2014 was of 68% and 65%, respectively<sup>41</sup>. Valladolid City council will continuously determine the level of satisfaction regarding the quality and quantity of green spaces in the city through Local Agenda 21 Indicators, so the effect of URBAN GreenUP can be quantified.

CHALLENGE 7: Participator	y Planning and Governance.
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Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 7: Participatory	Social	Perceptions of citizens on urban nature - Green spaces quality	(% satisfaction)

<sup>&</sup>lt;sup>39</sup> Valladolid City Council Air Pollution Control Network (RCCAVA) (2017) Available at: www.valladolid.es/es/rccava/datos-red/datosactualizados-temporales

<sup>&</sup>lt;sup>41</sup> Agenda local 21, 2014. Indicadores de Desarrollo Sostenible en Valladolid. Ayuntamiento de Valladolid. Available at: http://www.valladolidagendalocal21.es/





<sup>&</sup>lt;sup>40</sup> Søvik, a K., Augustin, J., Heikkinen, K., Huttunen, J. T., Necki, J. M., Karjalainen, S. M., ... Wachniew, P. (2006). Emission of the greenhouse gases nitrous oxide and methane from constructed wetlands in europe. *Journal of Environmental Quality*, *35*(6), 2360–73.

Planning and		
Governance		

Look at: "Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale). Green spaces quantity" from previous sections (Challenge 6 Urban Regeneration).

#### **CHALLENGE 8: Social Justice and Social Cohesion.**

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 8: Social Justice and Social Cohesion	Social cohesion	Green intelligence awareness	(nº educ. actions) (inhab attended)

No data is available at the present moment in terms of the green intelligence awareness of Valladolid citizens. However, VAc13 and VAc14 will focus on environmental awareness activities oriented to the civil population. Guided visits and other activities will be programmed, thus, contributing to raise the green intelligence awareness of Valladolid citizens.

### CHALLENGE 10: Potential of economic opportunities and green jobs.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE	Economic	Number of jobs created; gross value added	(jobs) (GDP)
10: Economic			
opportunities			

The implementation of VAc13 and VAc14 may contribute to the creation of green jobs, related to the construction, and later operation and control of the NWTP (that will be assume by AQUAVALL) and the environmental awareness activities programmed in the surroundings of the treatment facility.

# 4.3.3 Floodable Park area

# Current status of the area

The main action, VAc11 Floodable Park, is joined with other related actions that will be installed in the same zone, VAc7, VAc12, VAc18, VAc31 and VAc35. That is why we call that complete zone "Floodable Park Area".

Nowadays, the plot where the floodable park will be located is within the scope of Sector 50 of developable land, called "Los Santos 2", with a plan definitively approved for its development (BOCyL, 27<sup>th</sup> June 2006). At the moment, there are neither constructions nor infrastructures in the plot. There is only a power line that crosses the plot from north to south. The river Esgueva runs at a distance of approximately 15 meters south from the southern boundary of the plot.







Figure 4.5: Boundaries of the plot where the floodable park will be located

The plot has a total area of 70,315 m<sup>2</sup>, of which 56,552.92 m<sup>2</sup> are intended for parks and gardens, 7,715.83 m<sup>2</sup> for roads and pavements and 5,961.31 m<sup>2</sup> for facilities. Both the road surfaces and the paths and road locations (drawn in white in the image below) and the plot for planned facilities (pink area in the image below) must be free of building, which means that the floodable park cannot be located in those places. The inner roads must be developed and paid by the approved plan's owners.



Figure 4.6: Land classification for the plot where the floodable park will be located.

At present, the Esgueva river, which flows through the city of Valladolid, causes important damages even with floods of small return period (T = 10 years).



Figure 4.7: Flood hazard map of Pisuerga and Esgueva rivers throughout the city of Valladolid for a flood of 10 years return period.



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For this reason, for the purpose to mitigate such damages, a floodable park has been proposed in order to fulfill a double aim: on the one hand, under standard flow conditions, the land will be intended to a public park for citizens' use. On the other hand, under extraordinary flood conditions of the river Esgueva, the park must provide the function of retention pond with the objective of delaying and diminishing the peak flow value of the possible floods, trying to mitigate the potential damages that could be caused.

It is estimated that the floodable park has an area of approximately 50,700 m<sup>2</sup>, of which 35,700 m<sup>2</sup> will be dug and used as a retention pond with a temporary water storage capacity of about 90,000 m<sup>3</sup>. Likewise, it is possible that the floodable park has a permanent small lake. In the images below, sketches of the floodable park could be observed under standard and extraordinary flow conditions.



Figure 4.8: Sketch of the floodable park under standard flow conditions.

Figure 4.9: Sketch of the floodable park under extraordinary flow conditions.

# NBS description

**VAc11-** A floodable park with capacity to absorb the flow peaks from Esgueva River.

Floodable Park



The Esgueva River goes across Valladolid and a floodable park will be installed where the river causes floods (in storm periods). VAc11 will have 40,000 m<sup>2</sup> and will have capacity to

absorb the flow peaks that can occur for 6 hours. This intervention integrates other NBS (VAc7, VAc12, VAc18, VAc31 and VAc35).

VAc7-Urban Carbon Sink is an urban woodland with trees adapted to temporary floodUrbanconditions and high capacity of carbon sequestration.

**Carbon Sink** VAc7 is integrated into VAc12 and will consist in the installation of urban woodland (1,500 trees & 40,000 m<sup>2</sup>) with appropriate species adapted to temporary flood condition and with high capacity of carbon sequestration (*Fraxinus spp., Betula spp., Salix spp., Populus spp.* etc.). The trees of this forest will be allocated in specific arboreal series. This area will be a new urban carbon sink and will form a new urban ecosystem to preserve the biodiversity. Likewise, this woodland will provide biomass to energy use with social and economic purposes.





VAc12- Green filter area	Installation of a green filter zone close to Floodable Park area. VAc12 is integrated into VAc11 and will consist in the installation of a green filter zone (10,000 m <sup>2</sup> ), which completes the activity of the Floodable Park (VAc11). This filtering area will treat water from Esgueva River to irrigate nearby garden zones. 1,700 trees of specific species for green filter activity will be used ( <i>Populus spp., Eucalyptus spp.</i> , etc.).
VAc18- Smarts soils as substrate	Innovative soil with auto-fertilizing and NOX fixing properties. This innovative smart soil with auto-fertilizing and NOx fixing properties will be use in actions VAc7 and VAc14 (301 m3).
VAc35- Educationa I path	<i>Educational path in Floodable Park area.</i> A natural path to promote educational activities related to innovations on flood risk decrease, CO <sub>2</sub> sequestration/urban carbon sink and other.

Table 4.15: NBS of Sub-Demo C "Floodable park area"

### Baseline calculation of the area

With this NBS consisting of a floodable park, the URBAN GreenUP project wants to achieve the following Challenges and evaluate their achievement through different KPIs.

In this area an educational path will be built. Therefore, the selected KPIs for non-technical actions will be also applied.

### CHALLENGE 1: Climate mitigation & adaptation.

Eklipse	Type of	KPI Definition	KPI Unit
challenge	indicator		
CHALLENGE 1: Climate mitigation & adaptation	Carbon savings per unit area Carbon storage and sequestration	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(ton CO2/Ha) (ton CO2/year)

As we mention in the previous *Tree related actions*, this indicator will be calculated using a methodology that has yet to be defined completely.

#### See 4.1.2 Tree related actions and vertical.

### CHALLENGE 2: Water Management.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 2: Water Management	Physical indicators	Absorption capacity of green surfaces, bioretention structures and single trees.	(m3/m2) (m3/tree)
		Area (Ha) and population (inhab.) exposed to flooding in the city of Valladolid.	(Ha) (inhab.)


	Decrease of peak flow values for different return periods of Esgueva river just upstream the city of Valladolid.	(m3/s)
	Population exposed to flood risk (% respect Valladolid population).	(% )
Chemical indic.	Nutrient abatement, abatement of pollutants (%, nutrient load, heavy metals).	COD (mg/l); BOD (mg/l); SST (mg/l)
(water quality)	Water for irrigations purposes (m3 ha-1year-1)	(m3/ha/year)

In this section the main objective of the floodable park is to reduce both flood hazard and flood risk in the city of Valladolid due to Esgueva river floods. Current status of the area and expected status must be studied for different statistical return periods:

- Floods with a low probability, or extreme event scenarios (500 years return period).
- Floods with a medium probability (100 years return period).
- Floods with a high probability (10 years return period).

On the one hand, for each scenario studied the following elements shall be taken into account when assessing flood hazard:

- The flood extent.
- Water depths or water level.
- The flow velocity or the relevant water flow, where appropriate.

On the other hand, flood risk maps show the potential adverse consequences associated with the referred flood scenarios and expressed in terms of the following:

- The indicative number of inhabitants potentially affected.
- Type of economic activity of the area potentially affected.

There are four KPIs that should be monitored to study the results of floodable parks. Currently, we can consult all the information and data related to these KPI's in the National Flood Zone Mapping System (<u>http://sig.mapama.es/snczi/visor.html</u>). In this web site there are different layers which show flood extent, water depths, number of inhabitants potentially affected or type of economic activity of the area potentially affected, among others, for floods with different return periods. These data are useful to assess the current status of the area. During the URBAN GreenUP project we would use this information to analyse the influence of the floodable park on flooding episodes.

KPI description	Data values
Area (Ha) and population (inhab) exposed to flooding in the city of Valladolid.	340 Ha and 54.424 inhabitants (10 years return period flood) 620 Ha and 99.312 inhabitants (100 years return period flood) 1.497 Ha and 239.672 inhabitants (500 years return period flood)





KPI description	Data values
Decrease of peak flow values for different return periods of Esgueva river just upstream the city of Valladolid.	Flow: 20 m <sup>3</sup> /s (10 years return period flood) Flow: 56 m <sup>3</sup> /s (100 years return period flood) Flow: 109 m <sup>3</sup> /s (500 years return period flood)
Population exposed to flood risk (% total inhabitants in the municipality of Valladolid).	17,47% total inhabitants (10 years return period flood) 31,88% total inhabitants (100 years return period flood) 76,94% total inhabitants (500 years return period flood)

Table 4.16: Current data values for the KPI's selected from Challenge 2 for the floodable park action.

In order to know and measure the impacts and effects of the floodable park on these KPI's, Flood models will be developed by Confederación Hidrográfica del Duero during the URBAN GreenUP project.

Absorption capacity of green surfaces, bioretention structures and single trees indicator is directly related to the infiltration/drainage capacity of soils. It could be assessed at high or at local level for the quantification of run-off coefficient at city or local flood risks reductions. The methodology for calculating it is not established but there are references that are being discussing at NBS European projects level in Task force groups promoted by EASME and EU Commission. URBAN GreenUP will adopt the methodology selected and will determine the baseline.

On the other hand, the green filter area (VAc12) will allow also the treatment of the water of the Esgueva River and the reuse of the reclaimed water. Therefore, VAc12 will also impact on chemical indicators such as the abatement of nutrients (and organic matter) and water for irrigation purposes. The performances of green filters for water treatment are similar to the ones achievable in the NTWP. The main difference is that VAc12 will treat the water from the Esgueva River and not wastewater as in VAc13. Consequently, the amount of nutrients removed will depend on the quality of the inlet water (water from the River) and will have to be monitored along the URBAN GreenUP project. The estimated volume for water reuse is 4,500 m<sup>3</sup>/year. This volume will be addressed mainly to irrigation purposes.

### **CHALLENGE 4: Green Space Management**

For this Challenge, two KPI's have been selected for the floodable park and the green filter in VAc12. The first one is related to the proximity of public green spaces, parks and gardens to citizens. With this intervention we provide a new green space with an area of approximately 50,700 m<sup>2</sup>.

The second KPI of this challenge refers to the total area and surface per capita of public green spaces, parks and gardens existing in the city of Valladolid.

Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 4: Green Space Management	Social indicators (benefits)	Accessibility to green zones (measured as % inhabitants of city of Valladolid living closer than 500 m. of any green area bigger than 5,000 m2).	(%)





Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
		Distribution of public green space (measured both as total area and surface per capita).	(Ha) (m2/inhab)

In this meaning, the accessibility to green zones measured as % inhabitants of city of Valladolid living closer than 500 m. of any green area bigger than 5,000 m<sup>2</sup> can be obtained from the Sustainability Indicators of Local Agenda 21 Valladolid. The following link leads to the referred document:

http://valladol-cp76.webjoom la.es/concejalia/agendalocal 21/indicadores/indicadoressostenibilidad 2014.pdf

Conversely, the useful information needed to perform the second KPI under Challenge 4 regarding the distribution of public green space with the city of Valladolid could be consulted in the Environment and Sustainable Development Department of the Valladolid City Council.

KPI description	Data values
Accessibility to green zones (measured as % inhabitants of city of Valladolid living closer than 500 m. of any green area bigger than 5,000 m <sup>2</sup> ).	96,06% (data of 2014)
Distribution of public green space (measured both as total area and surface per capita).	515,79 Ha 17,09m²/inhab.

Table 4.17: Current data values for the KPI's selected from Challenge 4 for the floodable park action

#### CHALLENGE 5: Air quality.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 5: Air quality	Environmental (chemical)	Trends in emissions NOX, SOX	(μg/m3) SO2 (μg/m3) NO (μg/m3) NO2

Smart soils will be able to capture NOx and SOx, through their properties of atmospheric pollutants capture and inclusion of self-fertilizing properties by transforming these gases into nutrients for the soil. This indicator will be assessed and calculated through data from RCCAVA.

#### CHALLENGE 9: Public Health and Well-being

The last Challenge addressed is related to Public Health and Well-being. It estimates the increase in walking and cycling in and around the floodable park.

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 9:	Health indicators related	Increase in walking and cycling	(users)
Public Health	to ecosystem service	in and around areas of	(dicycles)
and Well-being	provision	interventions.	(Dicycles)

Currently, there are neither constructions nor infrastructures in the plot in which the floodable park will be located. Consequently, the base number of walkers and bikers in current situation is zero.





From URBAN GreenUP project, we consider that it would be necessary to monitoring the evolution of the number of both walkers and bikers when the floodable park was finished. It is possible that this information could be consulted in the Mobility Department of the Valladolid City Council.

### 4.3.4 Natural pollinator's modules

#### Current status of the area

No pollinator modules currently installed in the city of Valladolid have been identified.

#### **NBS** description

VAc21- Natural	Installation of water fountain, housing facility for pollinators and birds, bushes and aromatics species in natural ground.
pollinator's modules	Six units of VAc21 will be designed and installed in the Wastewater Plant zone, 3 units in Alameda Park zone (Urban Farming activities) and 6 units in the Floodable Park (Esgueva River zone).

Table 4.18: NBS of Sub-Demo C "Natural pollinator's modules"

#### Baseline calculation of the area

As we commented previously for the action VAc19 in section 4.1.3, currently in the city, there are no pollinator modules as such. However, all over the city are green areas with some of the characteristics of the pollinator modules, more specifically the natural pollinator's modules.

See 4.1.3 Natural pollinator's modules.

### 4.3.5 Urban Farming

#### Current status of the area

The city of Valladolid since 2016 provides public spaces to locate ecological orchards for the unemployed and for community exploitation (associations), established through a collaboration agreement between the Valladolid City Council and the Instituto Nevares de Empresarios Agrarios (INEA)<sup>42</sup>.

Currently in the city there are 410 orchards for retired people, 10 orchards for social organisations and 183 orchard for unemployed people, these last distributed in four areas of the city. They are periodically performed educational actions that show *How to grow and organic garden*. Concurrently, they aid to beneficiaries and all those interested, to learn how to grow and take care of an organic orchard.

Alameda Park orchards are only for the unemployed (although there is a space for a community garden that is not currently occupied). The gardens for retired people are in the Camino Viejo de Simancas, in INEA.

<sup>&</sup>lt;sup>42</sup> Valladolid urban orchards <u>http://www.valladolid.es/es/actualidad/noticias/huertos-ecologicos-2016-2017</u>







Figure 4.10: Urban farming in Alameda Park Valladolid (Source: Valladolid City Council)

#### **NBS** description

VAc31- Urban orchards	Urban orchards areas for organic farming and educational activities. Installed in Alameda Park zone (2 Ha) and in the Floodable park area (2 Ha) Unemployed/retired people may exploit them. VAc31 will improve social cohesion, builds a stronger appreciation for life (Biophilia concept) and has a educational impact in citizens.		
VAc32- Community composting	Community composting facility. A composting facility (with educational and engagement purpose) will be installed in the Urban Orchard area (Alameda Park zone). The organic agriculture wastes of orchards and nearby restaurants may be used as fertilizer after composting processes.		
VAc33- Small-scale urban livestock	Small-scale urban live-stock (henhouse)As a way to complete urban farming interventions, it is foreseen to install a small Scale livestock facility next to Urban Orchard area (Alameda Park zone). Private sponsor this activity providing animals		
VAc36- Urban farming educationa l activities	<i>Educational activities about urban farming and environmental awareness.</i> It is foreseen the realization of educational activities in the urban farming frame for the development of Urban Farming and a Bio-culture school.		

Table 4.19: NBS of Sub-Demo C "Urban farming in Alameda Park"

#### Baseline calculation of the area

As it has been said, in municipal orchards there are periodically educational actions about urban farming. Nevertheless, current activities might be not enough, and they are not related specifically to the NBS solutions.





We have initially selected five indicators to assess the impact of this solution. These indicators will provide information overall on social impacts and urban structure. Urban farming activities are involved to a greater or lesser extend in all EKLIPSEs challenges; for that reason we decided which challenges are more related, and these are Challenges 4, 6 and 10. Urban farming have many health and social benefits.

Eklipse Challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 4: Green Space Management	Social indicators (benefits)	Accessibility to green zones (measured as % inhabitants of city of Valladolid living closer than 500 m. of any green area bigger than 5,000 m2).	(%)
		Being valued for recreation, social interaction, education and supporting healthy living.	(% satisfaction)

*Increased connectivity to existing GI* is a high-level indicator and it will measure the connectivity among the green areas in the city. The methodology for calculating it is not established but there are references in other projects at European level with which they are doing clustering those are working to create a common framework like MAES<sup>43</sup>. URBAN GreenUP will adopt the methodology selected and will determine the baseline.

On the other hand, these green spaces are a space with many benefits; it is clear the relation with the *Recreation and Social Interaction*, as well as, the educational part of these activities regardless of age or gender. However, there are no studies on health benefits or well-being so it could be defined in the forthcoming months.

#### CHALLENGE 6: Urban Regeneration

Eklipse challenge	Type of indicator	KPI Definition	
CHALLENGE 6:	Urban groop	Enhance biodiversity and community	
Urban	indicators	engagement. Convert brownfield to green areas	(m2)
Regeneration	mulcators	in urban regeneration projects.	

It will be defined parallel to the Challenge 4 - Green Space Management.

#### CHALLENGE 10: Potential for Economic opportunities and green jobs

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 10: Potential of economic opportunities	Economic	Health and social benefits: Positive health effects, improved water management or recreational services	№ people who find a job and leave the urban orchard

<sup>&</sup>lt;sup>43</sup> https://biodiversity.europa.eu/maes/





Number of jobs created: Number of people who find a job and leave the urban orchard.	(jobs) (kg compost/year) (€saved/year)
Gross value added: Compost production	
(kg/year) (€/year)	

Be on unemployment generates gloom in people, by way of the responsibility of having to manage and maintain an orchard and the community engagement between beneficiaries is possible to fell more strong and be able to form a company or find work more effectively.

On the other hand, urban composting facilities will generate Compost as a product, which has an economic value ( $\in$ ) that can be calculated from the amount generated (tons).

Procedure and methodology will be defined in the forthcoming months and baseline of the areas of interventions will be established<sup>44</sup>.

### 4.4 Non-Technical actions

### Current status of the area

Valladolid City Council has a remarkable background in the matter of transparency, access to public information, public participation and good governance. In Valladolid there are implemented actions such as the Municipal Information Service, the Suggestions and Complaints Commission, electronic citizen services and the Open Data section on the municipal website, the Transparency Portal, municipal instruction for the promotion of transparency in public procurement or the School of Citizen Participation.

### **NBS** description

VAc37-	Engagement portal for citizens.				
Engagement portal for citizens	In this portal citizenship may know, comment, attend and take part in the project activities. This portal will be connected to the platform and smart apps of city of Valladolid ( <i>Valladolid in my pocket</i> ) to develop citizen awareness on re-naturing issues (cooler streets, nearby green areas, cycle lane connections, etc.).				
VAc38- Sponsoring activities	Sponsoring activities. Promotion of sponsoring activities program through which citizens may adopt/sponsor singular GI.				
VAc39-	Promotion of ecological reasoning and ecological intelligence.				
ecological reasoning and intelligence	It will be promoted the concepts of ecological reasoning and ecological intelligence by the development of awareness activities, which will include school ecological workshops, thematic meetings and the development of diffusion material.				

<sup>&</sup>lt;sup>44</sup> Positive health effects, improved water management or recreational services (BOP Consulting, 2013; Elmqvist et al., 2015; McConnell and Walls, 2005; TEEB, 2011; van den Berg et al., 2015)





VAc40- Single window/des k	Single desk for Renaturing Urban Plans (RUP) deployment. A new platform that comprises a major simplification of the re-naturing process concerning technical, administrative and funding aspects will be implemented to reach a high potential for local individual initiatives.				
VAc41- Support to citizen	Support to citizen projects of NBS. This complementary action will create a NBS cadastre developed in the Valladolid Urban Platform. The objective is that Valladolid will promote and facilitate the development of Green projects from citizens and private companies.				
VAc42- City mentoring	City mentoring strategy. In the course of WP1 and WP6, a number of good practices from Valladolid will be selected for mentoring purposes. Members of Valladolid consortium will be selected as mentors so that they can explain in detail their experience and how they think that could be used by other cities.				

Table 4.20: NBS of Sub-Demo A-B-C "Non-technical actions"

### Baseline calculation of the area

#### CHALLENGE 6: Urban Regeneration

Eklipse challenge	Type of indicator	KPI Definition KPI Un		
CHALLENGE 6: Urban Regeneration	Urban green indicators	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale; ): - Green spaces quantity	(% satisfaction)	

#### **CHALLENGE 7: Participatory Planning and Governance**

Eklipse challenge	Type of indicator	KPI Definition	KPI Unit
CHALLENGE 7:		Perceptions of citizens on urban nature:	
Participatory	Social	<ul> <li>Green spaces quality</li> </ul>	(%
Planning and	SUCIAI	- Water for drinking quality	satisfaction)
Governance		- Air quality	

Sustainability indicators of Local Agenda 21 of Valladolid provide information differente satisfaction indicators: (1) Green spaces quality indicator = 65% satisfaction (2014). (2) Drinking water quality indicator = 53% satisfaction (2014). (3) Air quality indicator = 52% satisfaction (2014).

Valladolid City Council will determine those AL21 indicators biannually, so the effect of URBAN GreenUP can be quantified.

As it is said before, URBAN GreenUP project contemplates the development of satisfaction and citizens' use surveys, by means of the URBAN GreenUP Android mobile application (App). These





surveys will aim at identifying social perception and wellbeing in population by means of satisfaction measures.

		8	
Fklipse	Type of	KPI Definition	К

CHALLENGE 10: Potential fo	r Economic opportunities	and green jobs
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Eklipse challenge	Type of indicator	KPI Definition	KPI Unit	
CHALLENGE 10: Potential of economic opportunities	Economic	Number of jobs created; gross value added	(jobs) (GDP)	

In general, it is planned to calculate the number of jobs generated directly and indirectly through the application of the BSS provided for in the URBAN GreenUP project.



## 5 Conclusions

This deliverable shows the Demonstration Project planned for Valladolid and the current state of the Baseline definition and calculation process, within the URBAN GreenUP Project.

The **selection of the demo areas** is intended to enable the analysis of a variety of scenarios with different characteristics allowing the establishment of a more solid methodology, related also to challenges and limits and the way to address them.

The Baseline is the established state by which KPIs will be measured or compared, before and after the measures implementation in the Demo Site.

Baseline seeks to establish the starting conditions on which the project will be developed. This includes the analysis of the **regulations** which apply at Local level (Ordinances), but also starting with European, National and Regional levels.

For each Nature Based Solutions (NBS) Group the implementing regulations have been identified, which can be grouped into water and flood risk regulations, vegetation species selection and parks and gardens maintenance, urban planning, noise and air quality, environmental education, transparency and good governance and local licensing.

In this document the **challenges and limitations** that apply to each NBS group have been also identified. The challenges have been classified into 6 categories: public management, administrative, technical, economic, environmental and social.

Regarding *Public Management* there have been identified four main challenges and limitations. First, slow periods for public tendering and processing may generate delays in the project chronogram. Second, local regulations (licenses, ordinances) may not be adapted to the types of URBAN GreenUP green solutions (p.e. public thoroughfare occupation, plant species selection or vegetation disease control products). In third place, Valladolid City Council must also define final locations for the different actions, and this process may also be slow. Finally, the need of maintenance even after project ending have to be considered.

The *Administrative* challenges identified are the internal coordination among Valladolid City Council Areas responsible for the permits emission and NBS control and maintenance: Urban Planning, Infrastructures, Environment, Parks and Gardens and Innovation Agency, among others. Lack of correspondence between the URBAN GreenUP project and the Political agenda could also interfere in the proper deployment of planned actions.

Every NBS type has its own *Technical* challenges and limitations. Lack of space to develop the NBS is one challenge that many actions might have. Lack of companies with experience in the implementation of the NBS in Valladolid area is another identified limitation.

Regarding to *Economic* constraints, some of the NBS will need maintenance operations which could have not been considered into the initial budget. Grown trees maximize survival success, but their cost is higher. Additionally, Floodable park location will need previous studies, which cost was not foreseen either. Finally, non-technical actions have not either been considered into the initial budget.





Main *Social* challenge found is that citizens do not actually know what NBS or Green infrastructure are, which could lead to citizen rejection because citizens are directly affected by the NBS.

In the Baseline, the **key performance indicators (KPIs)** that will show the results of each NBS group have been identified. For the city of Valladolid there have been initially selected 46 KPIs, which includes 29 core KPIs. For every EKPLISE Challenge and KPI, the type of indicator and measure unit are identified. KPI proposed unit shows an initial measure method identified for every NBS, although both the accurate definition of the KPIs and their use to define the Baseline will be completed in the forthcoming months.

For every KPI, the currently available **data sources** for calculating the Baseline have been identified. Also it has been identified the data sources that do not currently exist but are expected within the URBAN GreenUP project. KPIs are grouped into technical, economic and social indicators.

*Climate mitigation & adaptation* indicators (Challenge 1), seek to calculate avoided GHG emissions and CO<sub>2</sub> absorption by plants and soil but also temperature reduction. It will be demonstrated by for almost all technical actions to be carried out in Valladolid, mainly Green cycle lane, Tree related actions, Natural Wastewater Treatment Plant (NWTP), Green Parking Pavements, Vertical and Horizontal green interventions and Electro wetland. These KPIs will be calculated using IPCC methodology, from the trees and brushes census in Valladolid. Temperature reduction will be obtained from Spanish State Meteorological Agency (AEMET) and from the Valladolid City Council Air Pollution Control Network (RCCAVA).

*Water Management* indicators (Challenge 2) will be demonstrated technically by absorption capacity, run-off coefficient, areas and population exposed to flooding, intercepted rainfall and improvement in water quality like nutrient and pollutants abatement. It will be mainly demonstrated by water related actions such as NWTP, SUDs, rain gardens, green pavements and floodable park but also smart soils and tree related actions have the capacity to retain water and facilitate surface infiltration. These KPIs will be calculated getting annual rainfall data from AEMET and RCCAVA and runoff retention data obtained from literature. There has also been selected economic indicators which have not been assigned yet.

*Green Space Management* (Challenge 4) is being demonstrated by Accessibility for population to green infrastructures (GI) and increased connectivity to existing GI, among others. Local Agenda 21 of Valladolid provides every two years Sustainability indicators such as Inhabitants living closer than 500 m of any green area. Increased connectivity will be calculated with GIS analysis tools. Production of food is another KPI which will be calculated in urban orchards. Pollinator species increase will be also measured belonging to this Challenge.

*Air Quality* (Challenge 5) will be measured in terms of concentration and trends in emissions of different pollutants (NOX, SOX, CO, particulate matter) from the RCCAVA, with daily data available. URBAN GreenUP project will also include a new sensors network for temperature and humidity. NBS that will demonstrate these KPIs are specially the urban garden bio-filter, tree related actions, vertical and horizontal green interventions but also smarts soils, the electro wetland and green cycle lane.





*Urban Regeneration* (Challenge 6) is also being calculated as Accessibility, in terms of distribution, configuration, and diversity of green space and land use changes (which measured method is not defined yet, but it might be like green spaces quantity, total green cycle lane kilometres which substitute road transport or citizens' satisfaction); and also Savings in energy use due to improved GI. It is expected to install electricity meters to measure the expenses in air conditioning and heating. NBS which demonstrate this Challenge are green cycle lane, green pavements, vertical and horizontal green interventions and the electro wetland. This challenge will be also demonstrated by enhance biodiversity and community engagement, shown in the urban farming promotion activities.

*Participatory Planning and Governance* (Challenge 7) aims to measure the citizens' perceptions on urban nature. It will be measured in every NBS located in the city, especially in the actions for the promotion of NBS at citizen scale. Satisfaction degree and citizens' perceptions for green solutions are difficult to measure. In Valladolid we will use the Local Agenda 21 indicators, such as Green spaces quality, Water for drinking quality and Air quality. In URBAN GreenUP the development of a mobile application to collect the citizens' opinions through simple surveys is also planned.

*Social Justice and Social Cohesion* (Challenge 8) measured as green intelligence awareness will be calculated through educational activities, in the urban farming area, floodable park, NWTP, or electro wetland.

*Public Health and Well-being* (Challenge 9) will be identified on the one hand by KPIs such as Increase in walking and cycling in and around areas of interventions, measured as number of users, or bicycles in the green cycle lane. Data will be obtained from the mobile application, the citizen observatory, but also from the Mobility statistics. On the other hand, positive impacts against noise will be also measured in terms of exposed population to noise and noise reduction rates; and data will be obtained from Municipal Plan against Noise Pollution of Valladolid and RCCAVA. This Challenge KPIs are especially important in green noise barriers, tree related actions, vertical and horizontal green actions and green pavements.

*Potential of economic opportunities* (Challenge 10) will be measured through the KPI New businesses attracted and additional business rates. New business opened data will be obtained from Valladolid City Council in the Opening License Department. All NBS could contribute to the generation of employment and economic power in a direct or indirect way.

In the coming months and before the beginning of the NBS construction in Valladolid Demo-Site, we must continue working to obtain the Baseline data, defining calculation methods, and calculating all KPIs which will determine a good and detailed baseline for the city of Valladolid.







## **URBAN GreenUP**

# Annexes to D2.2



Authors: VAL, CAR, ACC, SGR, CEN, CHD, GMV and LEI URBAN GreenUP SCC-02-2016-2017 Innovation Action – GRANT AGREEMENT No. 730426

D2.2	Urban GreenUP KPIs table for Valladolid			Description: This table joins the 29 Global KPIs         Description: 'NBS' identifies in general           and 34 pre-selected Valladolid KPIs.         the NBS group with their KPI's.					
CHALLENGES	TYPE OF INDICATORS	КРІ	KPI Unit (proposed)	SCALE R=Regional M=Metropolitan U=Urban S=Street B=Building	ECOSYSTEM SERVICES 1. provisioning; 2. regulating; 3. supporting; 4. cultural	VALLAD OLID	ESA core KPIs	Pre-selected Valladolid NBS	
CHALLENGE 1:	Carbon savings per unit area (environmental, chemical) Carbon storage and sequestration in vegetation and soil	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(ton CO2/Ha) (ton CO2/year) (ton)	>R	Regulation	x	1	Tree related actions;	
Climate mitigation & adaptation	Temperature reduction (environmental, physical)	Decrease in mean or peak daytime local temperatures (°C) Heatwave risks (number of combined tropical nights (>20 °C) and hot days (>35	(°C)	RMU	Regulation	x	1	Tree related actions;	
	Others	°C) Use of <i>Star tools</i> to calculate projected maximum surface temperature	(°C)	MU	Regulation	x	1	Tree related actions;	
		reduction (°C) Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)	R M U S B	Regulation	x	1		
		Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	S B	Supporting	x	1		
		Temperature reduction in urban areas (°C, % of energy reduction for cooling)	reduction for	RMUS	Regulation	x	1	Tree related actions; SUDs; Natural	
	Physical indicators	Flood peak reduction (lacob et al., 2014),	(%)	R M U S	Regulation	x	1	Wastewater Treatment Plan; Rain Gardens;	
		Reduction of drought risk (probability).		RM	Regulation	x		Floodable park; Green Parking pavements;	
CHALLENGE 2:		Intercepted rainfall (m3 year-1)	(m3 year-1)		Regulation	x		Electro wetland	
Water Management		Share of green areas in zones in danger of floods (%)	(%)		Regulation	x			
		Population exposed to flood risk (% per unit area) Nutrient abatement. abatement of pollutants (%, nutrient load, heavy metals).	(%/m2) Chemical Oxygen Demand (COD)	R	Regulation	x		Tree related actions;	
	Chemical indicators (water quality)		(mg/l);		Desuisianina		1	Gardens; Floodable park;	
	,,	Drinking water provision (m3 ha-1year-1) Water for irrigations purposes (m3 ha-1year-1)	(m3/ha/year) (m3/ha/year)		Provisioning	x	1	Green Parking pavements, Electro wetland	
	Economic indicators (honofits)	Volume of water removed from water treatment system	(€/m3)	U S B	Regulation	x	1	Eloodable park:	
	Economic indicators (benefits)	Volume of water slowed down entering sewer system	(€/m3)	U S B	Regulation	х	1	Floodable park,	
	Social indicators (benefits)	Accessionity (measured as distance or time) of urban green spaces for population (Tamosiunas et al., 2014). Weighted recreation opportunities provided by Urban Green Infrastructure	(m) (min)	R M U S	Cultural		1	Green cycle lane; Tree	
CHALLENGE 4:		(Derkzen et al. 2015) Distribution of public green space – total surface or per capita (Badiu et al.,	(m2/capita) (km	RMU	Cultural	×	-	related actions;	
Management	Environmental (biological)	2016; Gómez-Baggethun and Barton, 2013; La Rosa et al., 2016). Production of food (ton/Ha/year)	<sub>cvcle lane</sub> /capita) (ton/Ha/vear)		Provisioning	^	1	Green cycle lane; Tree related actions;	
		Increased connectivity to existing GI	(m) (%)	M U S	Supporting	x	1		
		Pollinator species increase (number)	(nº) (%)	U S	Supporting	х	1		
		Sustainability of green areas	Suprov		Cultural	x			
		Perceptions of connectivity and mobility	Survey		Cultural	x			
	Environmental (chemical)	Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities	(µg/m3) PM2.5		Regulation		1	Green cycle lane; Tree	
		Trends in emissions NOX, SOX	(μg/m3) PM10 (μg/m3) SO <sub>2</sub> (μg/m3) NO		Regulation	x	1	soils as substrate; Urban garden bio-filter; Vertical	
		Mean levels of exposure to ambient air pollution (population weighted) (proposed indicator for SDG target 3.9)	(inhab) (kg		Regulation	x		Horizontal green	
CHALLENGE 5: Air Quality	Economic	Monetary values: value of air pollution reduction; total monetary value of urban forests including air quality, run-off mitigation, energy savings, and increase in property values. use of GI val to calculate the value of air quality improvements	(€)	МU	Supporting	x	1	Tree related actions; Smarts soils as substrate; Urban garden bio-filter	
		Number of deaths from air, water and soil pollution and contamination	(nº deaths)		Supporting		1	Tree related actions;	
	Social (physiological)	Air quality parameters NOx, VOC, PM etc	(μg/m3) CO (mg/m3) O <sub>3</sub> (μg/m3) C <sub>6</sub> H <sub>6</sub> Quality air index (ICA)		Regulation	x	1	Smarts soils as substrate; Urban garden bio-filter; Vertical green interventions; Horizontal green interventions;	
CHALLENGE 6:	Urban green indicators (environmental, biological)	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale; ) Green spaces quantity	(nº species) (% satisfaction)	R M U	Cultural		1	Green cycle lane; Tree related actions;	
Urban Regeneration	Socio-cultural indicators	Savings in energy use due to improved GI	(kWh)		Regulation	х	1	Green cycla lana:	
	Socio-curtaral indicators	Assessment of typology, functionality and benefits provided pre and post interventions	(km cycle/km road)			х		Green cycle lane,	
CHALLENGE 7		Perceptions of citizens on urban nature - Green spaces quality	(% satisfaction)	R M U	Cultural		1		
Participatory Planning	Social	Openness of participatory processes (Frantzeskaki and Kabisch, 2016; Luyet et al., 2012; Uittenbroek et al., 2013).	(nº processes) (population)	R M U S	Cultural	х		Vertical green interventions;	
		Legitimacy of knowledge in participatory processes (Frantzeskaki and Kabisch, 2016; Luyet et al., 2012).	(type of population)	R M U	Cultural	x			
CHALLENGE 8: Social Justice and Social Cohesion	Social cohesion	Green intelligence awareness	(nº educ. actions) (inhab attended)		Cultural		1	Non-technical actions;	
	Psychological indicators (Relaxation and restoration, sense of place, exploratory behaviour, socializing).	Noise reduction rates applied to UGI within a defined road buffer dB(A) m-2 vegetation unit	(dB(A)/m2)	S B	Regulation		1	Vertical green interventions;	
CHALLENGE 9: Public Health and Well- being	Health indicators related to ecosystem service provision (Buffering of noise and air pollution, reduced heat, exposure to microflore).	Increase in walking and cycling in and around areas of interventions	(users) (bicycles)		Cultural		1	Green cycle lane; Vertical green interventions; Horzontal green interventions; Floodable park	
CHALLENGE 10:		Number of jobs created; gross value added	(jobs) (GDP)	R M U	Supporting	х	1	Tree related actions; Natural Wastewater	
Potential of	Fronomic	Number of subsidies or tax reductions applied for (private) NBS measures (Meulen et al., 2013).	(nº subsidies) (nº tax reductions)	RMUSB		х		Treatment Plant; Green	
opportunities		New businesses attracted and additional business rates (Eftec, 2013).	(business)	R M U		х		park; Green parking	
and green jobs		(Tyler et al., 2013) resulting from NBS.	(€)	RMU		х		pavements; Non-technical actions:	
		TOTAL NUMBER OF KPIs				34	29		

#### D2.2 Annex II. Regulations Also Good practice manuals and official guides.

NBS Code	NBS Group	NBS Description	Regulation	Website	Scale	Requirements
42 actions in Valladolid	NBS type by nature	NBS included in each group.	Name the Directive, Regulation, Royal Decree, Law, Decree Law, Ordinance, other. Identify the place and date of publication	Link to the source	E=European N= National R=Regional U=Urban	Describe the requirements contained in the regulation
VAc1 VAc6	New green cycle lane and re-naturing	Green cycle lane; Green resting areas; Cycle-pedestrian	Regulatory Ordinance of Bicycle Mobility in Valladolid Municipality (BOPV nº 67, 21 <sup>st</sup> March 2015)	http://www.valladolid.es/es/ciudad/medio-ambiente- salud/normativas/movilidad-bicicleta-termino_ municipal-valladolid-ordenanzaficheros/235332- MOVILIDADBICICLETASORD.pdf	U	Art. 1.2The bicycles will circulate obligatorily by lanes reserved for bicycles when they are properly signaled. Art. 1.6When the bicycles lane is located on the road, pedestrians can cross it, but can not occupy or walk.
VACIS	existing bike idnes	green paths	Comprehensive Urban, Sustainable and Safe Mobility Plan for the City of Valladolid (PIMUSSVA)	www.pimussva.es	U	Sector Program. Empowering non-motorized modes (Cyclist and pedestrian)
			Royal Decree 1628/2011, 14 <sup>th</sup> November, List and Spanish Catalogue of Exotic and Invasive Species (BOE nº 298, 12 <sup>th</sup> Dec 2011)	https://www.boe.es/boe/dias/2011/12/12 /pdfs/BOE-A-2011-19398.pdf	Ν	The plant species used on the NBS can not be on this list (Annex I, Annex II)
VAc2	Tree related actions	Planting 1,000 trees; Tree shady	Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.	http://www.boe.es/boe/dias/2012/09/15/ pdfs/BOE-A-2012-11605.pdf	Ν	[Plants and trees] This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.
VAc3 VAc4		places; Shade and cooling trees; Re-	Law 5/1999, 8th April, of Urban Planning of Castilla y León	https://www.boe.es/buscar/doc.php?id=B OE-A-1999-12599	R	Art.97 Acts subject to license. Require obtaining urban planning license, without prejudice to other interventions, acts of use of the that exceed the normal use of natural resources.
VAc5 VAc7		naturing parking trees; Urban Carbon Sink	General Urban Planning Plan (Plan General de Ordenación Urbana, PGOUVa 2012)	http://www.valladolid.es/en/temas/hacemos/avance- pgou-2012/fase-2-1-trabajos-informacion- urbanistica.files/81137- PGOUVa%20Informacion%20y%20Avance.pdf	U	X.b. Creation of a sustainable network of public green spaces where trees, roads and squares could take part of an ambicious system that aims to integrate the urban and the metropolitan ambit. 3. General orientations for trees management.
			Parks and Gardens Regulation of the City of Valladolid (BOP, 14 <sup>th</sup> March 1990)	www.valladolid.es/es/ayuntamiento/norm ativa/parques-jardines-ciudad-valladolid- reglamento	U	Article 18. 1. In sidewalks with a width of more than three meters, the ditch shall never be less than 0.80 x 0.80 meters, to facilitate the collection of both irrigation and rainwater. 2. In sidewalks with a width of less than three meters, for the small trees, the minimum dimension shall be $0,60 \times 0,60$ meters. 3. The edges of the ditch must be at the same level as the sidewalk to facilitate the collection of rainwater.
		SUDs for green bike lane; SUDs for re- naturing parking	Water Framework Directive (2000/60/EC) (Official Journal (OJ L 327) on 22nd December 2000)	http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:32000L0060	E	Protection and improving of water bodies. Promotion of sustainable uses of water. Protection and improving of aquatic ecosystems. Reduction of pollution of underground waters.
			EU Floods Directive (2007/60/EC)	http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:32007L0060	E	Requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. With this Directive also reinforces the rights of the public to access this information and to have a say in the planning process.
			Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20th July.	https://www.boe.es/buscar/act.php?id=B OE-A-2001-14276	N	Public Water Domain regulation, water use and competences.
VAc8 VAc9	SUDs		Regulation of the Public Hydraulic Domain which develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text , approved by Legislative Royal Decree 1/2001, of 20th July.	https://www.boe.es/buscar/act.php?id=B OE-A-1986-10638	Ν	Definition of the hydraulic public domain and its use and protection.
			Hydrological Plan of the Duero river basin district; approved by Royal Decree 907/2007 of 6th July	http://www.chduero.es/Inicio/Planificaci%C3%B3n/Pl anhidrol%C3%B3gico20152021/PlanHidrol%C3%B3gic o/tabid/734/Default.aspx	Ν	Objectives: water protection; water demands satisfaction, increase the availability of the resource, protect its quality, save costs and rationalize the uses.
			Royal Decree 903/2010, of Evaluation and Management of Floods Risks	https://www.boe.es/boe/dias/2010/07/15 /pdfs/BOE-A-2010-11184.pdf	Ν	Refernces to the management of floods in origin, such as those included in the plans for floods risk management in Articles 11 and 12.
			Technical Code for the Construction (CTE-DB-HS). Royal Dreee 314/2006	http://www.boe.es/buscar/act.php?id=BO E-A-2006-5515	Ν	Recommendations about facilities for the reuse of rainwater in domestic uses.
			Regulations for water supply and sanitation in Valladolid city (April, 2006)	http://www.aguasdevalladolid.com/PDF/R eglamento Valladolid.pdf	U	Rules for sewage water dicharge into the municipal sewerage

NBS Code	NBS Group	NBS Description	Regulation	Website	Scale	Requirements
			Water Framework Directive (2000/60/EC) (Official Journal (OJ L 327) on 22nd December 2000)	http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:32000L0060	E	Protection and improving of water bodies. Promotion of sustainable uses of water. Protection and improving of aquatic ecosystems. Reduction of pollution of underground waters.
			Urban WW Treatment Directive (91/271/EEC)	http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:31991L0271	E	Water discharge limits: 125 mg/l COD; 25 mg /l BDO5; 35 mg/l SS. Also N and P limits in sensitive areas (10- 15 mg/l Tn and 1-2 mg/l TP).
			Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20th July.	https://www.boe.es/buscar/act.php?id=B OE-A-2001-14276	Ν	Public Water Domain regulation, water use and competences.
		Natural Wastewater	Regulation of the Public Hydraulic Domain (BOE nº 103, 30/04/1986)	https://www.boe.es/buscar/act.php?id=B OE-A-1986-10638	Ν	Definition of the hydraulic public domain and its use and protection. This Regulation develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text , approved by Legislative Royal Decree 1/2001, of 20th July.
VA-12	Natural Wastewater		Hydrological Plan of the Duero river basin district; approved by Royal Decree 907/2007 of 6th July	http://www.chduero.es/Inicio/Planificaci% C3%B3n/Planhidrol%C3%B3gico20152021/ PlanHidrol%C3%B3gico/tabid/734/Default. aspx	N	Objectives: water protection; water demands satisfaction, increase the availability of the resource, protect its quality, save costs and rationalize the uses.
VAC13	Treatment Plant	(NWTP)	Royal Decree Law 11/1995, for Urban Wastewater treatment.	https://www.boe.es/buscar/doc.php?id=B OE-A-1995-27963	Ν	Transposition of the UWWT Directive. Water discharge limits: 125 mg/l COD; 25 mg /l BDO5; 35 mg/l SS. Also N and P limits in sensitive areas (10-15 mg/l Tn and 1-2 mg/l TP).
			Royal Decree 509/1996, which complements the RD Law 11/95, and its modification thorugh the RD 2116/1998	https://www.boe.es/diario_boe/txt.php?id =BOE-A-1996-7159	Ν	Adoption of limits for water discharge
			Resolution of 30th of June 2011 which declares sensitive areas in transboundary river basins.	https://www.boe.es/boe/dias/2011/07/28 /pdfs/BOE-A-2011-13028.pdf	Ν	It contains the declaration of Rio Pisuerga (Playa de las Moreras) as Sensitive area (requirements for nutrients removal).
			Royal Decree 1620/2007, Regulations for Water Reuse	https://www.boe.es/boe/dias/2007/12/08 /pdfs/A50639-50661.pdf	Ν	Potential reclaimed water uses depending on the water quality (i.e, for irrigation)
			Regulations for water supply and sanitation in Valladolid city (April, 2006)	http://www.aguasdevalladolid.com/PDF/R eglamento Valladolid.pdf	U	Rules for sewage water dicharge in the city of Valladolid
			Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.	http://www.boe.es/boe/dias/2012/09/15/ pdfs/BOE-A-2012-11605.pdf	Ν	[Plants and trees] This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.
			Water Framework Directive (2000/60/EC). Official Journal (OJ L 327) on 22 December 2000	http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:32000L0060	E	Protection and improving of water bodies. Promotion of sustainable uses of water. Protection and improving of aquatic ecosystems. Reduction of pollution of underground waters.
			EU Floods Directive (2007/60/EC)	http://eur-lex.europa.eu/legal_ content/EN/TXT/?uri=CELEX:32007L0060	E	requires Member States to assess if all water courses and coast lines are at risk from flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. With this Directive also reinforces the rights of the public to access this information and to have a say in the planning process.
			Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20th July.	https://www.boe.es/buscar/act.php?id=B OE-A-2001-14276	Ν	Public Water Domain regulation, water use and competences.
VAc10	Rain gardens	Rain gardens	Regulation of the Public Hydraulic Domain (BOE nº 103, 30/04/1986)	https://www.boe.es/buscar/act.php?id=B OE-A-1986-10638	Ν	Definition of the hydraulic public domain and its use and protection. This Regulation develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text , approved by Legislative Royal Decree 1/2001, of 20th July.
			Hydrological Plan of the Duero river basin district; approved by Royal Decree 907/2007 of 6th July	http://www.chduero.es/Inicio/Planificaci% C3%B3n/Planhidrol%C3%B3gico20152021/ PlanHidrol%C3%B3gico/tabid/734/Default.	Ν	Objectives: water protection; water demands satisfaction, increase the availability of the resource, protect its quality, save costs and rationalize the uses.
			Royal Decree 903/2010, of Evaluation and Management of Floods Risks	https://www.boe.es/boe/dias/2010/07/15 /pdfs/BOE-A-2010-11184.pdf	Ν	Refernces to the management of floods in origin, such as those included in the plans for floods risk management in articles 11 and 12.
		<u>۲</u> ۲	Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.	http://www.boe.es/boe/dias/2012/09/15/ pdfs/BOE-A-2012-11605.pdf	N	[Plants and trees] This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.

NBS Code	NBS Group	NBS Description	Regulation	Website	Scale	Requirements
			Water Framework Directive (2000/60/EC). Official Journal (OJ L 327) on 22 December 2000	http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:32000L0060	E	Protection and improving of water bodies. Promotion of sustainable uses of water. Protection and improving of aquatic ecosystems. Reduction of pollution of underground waters.
			Urban WWT Directive (91/271/EEC).	http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:31991L0271	E	Water discharge limits: 125 mg/l COD; 25 mg /l BDO5; 35 mg/l SS. Also N and P limits in sensitive areas (10-15 mg/l Tn and 1-2 mg/l TP).
			Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20th July.	https://www.boe.es/buscar/act.php?id=B OE-A-2001-14276	Ν	Public Water Domain regulation, water use and competences.
		Green filter area	Regulation of the Public Hydraulic Domain (BOE nº 103, 30/04/1986)	https://www.boe.es/buscar/act.php?id=B OE-A-1986-10638	Ν	Definition of the hydraulic public domain and its use and protection. This Regulation develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text , approved by Legislative Royal Decree 1/2001, of 20th July.
			Royal Decree Law 11/1995, for Urban Wastewater treatment.	https://www.boe.es/buscar/doc.php?id=B OE-A-1995-27963	Ν	Transposition of the UWWT Directive. Water discharge limits: 125 mg/l COD; 25 mg /l BDO5; 35 mg/l SS. Also N and P limits in sensitive areas (10-15 mg/l Tn and 1-2 mg/l TP).
VAc12	Green filter area		Royal Decree 509/1996, which complements the RD Law 11/95, and its modification thorugh the RD 2116/1998	https://www.boe.es/diario_boe/txt.php?id =BOE-A-1996-7159	Ν	Adoption of limits for water discharge
			Resolution of 30th of June 2011 which declares sensitive areas in transboundary river basins.	https://www.boe.es/boe/dias/2011/07/28 /pdfs/BOE-A-2011-13028.pdf	Ν	Declaration of Rio Pisuergas (Playa de las Moreras) as sensitive area (requirements for nutrients removal)
			Royal Decree 1620/2007, Regulations for Water Reuse.	https://www.boe.es/boe/dias/2007/12/08 /pdfs/A50639-50661.pdf	Ν	Potential reclaimed water uses depending on the water quality (i.e, for irrigation)
			Regulations for water supply and sanitation in Valladolid city (April, 2006)	http://www.aguasdevalladolid.com/PDF/R eglamento Valladolid.pdf	U	Rules for sewage water dicharge in the city of Valladolid
			Action Plan for Pollution Alert (BOPV 4th April 2017)	http://www.valladolid.es/es/rccava/plan- accion-situaciones-alerta	U	Alert situations: Situation1: Preventive; Situation 2: Notice; Situation 3: Alert.
			Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.	http://www.boe.es/boe/dias/2012/09/15/ pdfs/BOE-A-2012-11605.pdf	N	[Plants and trees] This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.
			Directive 2007/60/EC on the assessment and management of flood risks.	http://eur-lex.europa.eu/legal- content/EN/TXT/PDF/?uri=CELEX:32007L00 60&from=EN	E	Art. 7.3 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.
			Water Law Consolidated Text, approved by Legislative Royal Decree 1/2001, of 20 July.	https://www.boe.es/buscar/pdf/2001/BOE- A-2001-14276-consolidado.pdf	Ν	Public Water Domain regulation, water use and competences. Articles 6, 25.4 and 77: In order to develop any work that may affect the hydraulic public domain or that is located within the "policia" area, as it is the case of the floodable park, a prior administrative authorization from Confederación Hidrográfica del Duero must be requested. Art. 92. Objectives of protection. e) To mitigate the effects of floods and droughts.
			Regulation of the Public Hydraulic Domain which develops the preliminary titles I, IV, V, VI, VII and VIII of the Water Law Consolidated Text , approved by Legislative Royal Decree 1/2001, of 20th July.	https://www.boe.es/buscar/pdf/1986/BOE- A-1986-10638-consolidado.pdf	N	Articles 9.4 and 126: In order to develp any work that may affect the hydraulic public domain or that is located within the "policia" area, as it is the case of the floodable park, a prior administrative authorization from Confederación Hidrográfica del Duero must be requested. Title VII (from article 356 to article 368) embraces the safety of dams, reservoirs and ponds. Since the floodable park consists basically on a retention pond, this title of the regulation might result applicable. In this regard, holders of dams and ponds with a height of more than 5 meters or a reservoir capacity of more than 100,000 m3, of private or public ownership, existing, under construction or to be built, shall be required to request their classification and registration.
VAc11	Floodable park	Floodable park	Hydrological Plan of the Duero river basin district; approved by Royal Decree 907/2007 of 6th July	http://www.chduero.es/Inicio/Planificaci% C3%B3n/Planhidrol%C3%B3gico20152021/ PlanHidrol%C3%B3gico/tabid/734/Default.	Ν	Objectives: water protection; water demands satisfaction, increase the availability of the resource, protect its quality, save costs and rationalize the uses.
			Royal Decree 903/2010, of 9 July, on the assessment and management of flood risks.	https://www.boe.es/boe/dias/2010/07/15 /pdfs/BOE-A-2010-11184.pdf	Ν	Art. 11.4 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
		a B R N	Basic Guideline for Civil Protection Planning for Flood Risk approved by Agreement of the Council of Ministers of January 31, 1995.	http://www.boe.es/boe/dias/1995/02/14/ pdfs/A04846-04858.pdf	Ν	Access to the park must be controlled while flooding is taking place.

NBS Code	NBS Group	NBS Description	Regulation	Website	Scale	Requirements
			Flood Risk Management Plan of the Duero´s basin, approved by Royal Decree 18/2016, of 15 January.	http://www.chduero.es/Inicio/Gesti%C3% B3ndelaCuenca/Gesti%C3%B3nRiesgosdein undaci%C3%B3n/PlandeGesti%C3%B3ndel Riesgodelnundaci%C3%B3n/tabid/697/Def ault.aspx	R	Appendix 2: Description of the program of measures Measures in the riverbed and in the flood plains: river restoration, including measures of natural water retention (NWRM, Natural Water Retention Measures) and reforestation of rivers Improve resilience and reduce the vulnerability of elements located in flood areas. Reclaiming floodplains by removing obstacles to overflowing, or creating green infrastructures that improve water retention capacity, will increase the lamination of avenues in flood episodes so as to increase resilience and reduce damage in flood areas.
			Civil Protection Plan for Flood Risk in the Autonomous Community of Castilla y León (INUNcyl) (BOCYL 3 March 2010)	http://www.jcyl.es/web/jcyl/Administracio nPublica/es/Plantilla100/1283000221141/	R	To include the floodable park within the scope of the Civil Protection Plan for Flood Risk in the Autonomous Community of Castilla y León (INUNcyl).
VAc14	Green Parking Pavements	Green parking pavements	Land management and parking (Programa Sectorial. Ordenación del Viario y Aparcamiento) PIMUSSVA, November 2005.	http://www.pimussva.es/wp- content/uploads/2016/05/PIMUSSVA Prog rama Ordenacion Viaria y aparcamiento. pdf	U	Sectoral Program. Zones/ types to be considered. Parking volume.
VAc16 VAc17 VAc18	Smarts soils as substrate	Smarts soils for cycle-pedestrian paths (A); for green singular infrastructure (B); in NWTP zone (C)	Royal Decree 865/2010, of 2nd July (last modification 28th July 2012) on growing substrates.	http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX%3A52006PC0 232 http://eur-lex.europa.eu/legal- content/EN/TXT/?uri=CELEX:52012DC0046 https://www.boe.es/diario_boe/txt.php?id =BOE-A-2010-11153	U	There is no specific soil protection legislation in the EU. The proposed Directive for soil protection is stagnant in the first reading phase.
			Royal Decree 630/2013, of August 2, which regulates the Spanish Catalogue of invasive alien species. Ministry of Agriculture, Food and Environment.	http://www.mapama.gob.es/es/biodiversi dad/temas/conservacion-de- especies/especies-exoticas-invasoras/	N	
VAc19 VAc20 I VAc21	Pollinators modules	Natural pollinator's modules (A, C); Compacted modules (B)	Royal Decree 139/2011, of February 4, for the development of the List of Wild Species in Special Protection Regime and the Spanish Catalogue of Threatened Species.	http://www.mapama.gob.es/es/biodiversi dad/temas/conservacion-de- especies/especies-proteccion- especial/default.aspx	Ν	
			Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.	http://www.boe.es/boe/dias/2012/09/15/ pdfs/BOE-A-2012-11605.pdf	Ν	[Plants and trees] This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.

NBS Code	NBS Group	NBS Description	Regulation	Website	Scale	Requirements																	
			Law 37/2003 of 27th November, on Noise.	http://sicaweb.cedex.es/docs/leyes/Ley-37- 2003-del-ruido.pdf	Ν	Acoustic quality objectives are established for each area, including the interior space of certain buildings. Emission or immission limit values as well as noise and vibration assessment procedures and methods.																	
			Law 5/2009 of 4th June, on Noise in Castilla y León.	www.boe.es/buscar/pdf/2009/BOE-A-2009- 11125-consolidado.pdf	R	Acoustic quality objectives for Castilla y León region. Limits of emission and immission defined in Annex I.																	
			Ordinance on Noise and Vibrations (BOPV n° 122, 31 <sup>th</sup> May 2013)	www.valladolid.es/es/ciudad/medio- ambiente-salud/normativas/ruidos- vibraciones-ordenanza.ficheros/123883- 24%20OrdRUIDOS.pdf	U	The limits of emission and immission shall be as defined in Annex I of Law 5/2009, of the Noise of Castilla y León.																	
	Vertical green		Municipal Plan against Noise Pollution of Valladolid (2008)	http://valladol- cp76.webjoomla.es/concejalia/planes/plan accioncontraelruido.pdf	U	Area of Sustainable Development, Advanced Technologies and Territorial Coordination (Valladolid City Council)																	
			Royal Decree 1372/1986, of 13th June, on the Regulation of Goods of Local Entities.	https://www.boe.es/buscar/act.php?id=B OE-A-1986-17958	Ν	CHAPTER IV - Enjoyment and use of goods. Section 1. Use of public domain assets. Art. 77. The city council will grant the license of occupation of public road.																	
		Green noise barriers; Green vertical mobile garden; Green Gaçade	Regular Fiscal Ordinance of Taxes for Private or special use of the Municipal Public Space.	Link to the source	U	Chapter 6: Regulation of the rates for occupation of the public road.																	
VAc22 VAc23			Green noise barriers; Green vertical mobile garden; Green façade	Green noise barriers; Green vertical mobile garden; Green façade	Green noise oarriers; Green vertical mobile garden; Green façade	Green noise barriers; Green vertical mobile garden; Green Gaçade	Special Plan of the Historic Quarter, General Urban Planning Plan of Valladolid (BOPV, 27th Feb 2004)	I Plan of the Historic Quarter, General Urban ng Plan of Valladolid (BOPV, 27th Feb 2004) PGOU_Valladolid.ficheros/9347- PGOU_Valladolid.pdf		Urban Planning in the Historic Center of Valladolid (currently being updated - October 2017)													
VAc24 VAc25	interventions						arden; Green açade	arden; Green açade	arden; Green ( açade F	General plan of urban planning (PGOU)	https://cloud.valladolid.es/index.php/s/mx LvaigJvh3vSom	U	Article 72. Partial actions of conservation, repair and adaptation of façades.										
										açade	içade I	ıçade I	içade !	içade .	işuuc	açade	açade	ıçade R R S	çade R R s	çade R s <u>n</u>	çade F F S <u>r</u>	çade Ro Sr	içade Ro Ro Sţ n'
					Technical Building Code, CTE-DB-SI	https://www.codigotecnico.org/images/st ories/pdf/seguridadIncendio/DccSI.pdf	Ν	CTE-DB-SI2, 1.4 -The fire reaction rate of materials occupying more than 10% of the façades exterior finish surface or of the interior surfaces of the ventilated chambers shall be B-s3, d2.															
																	_		Technical Building Code, CTE-DB-SE	https://www.codigotecnico.org/images/st ories/pdf/seguridadEstructural/DBSE.pdf	N	CTE-DB-SE1, 4.4- It is considered that there is sufficient strength of the supporting structure, of a structural element, section, point or of a union between elements, if for all the relevant dimensioning situations the following condition is fulfilled: $Rd \le Ed$ Ed : calculation value of loads Rd : value of resistance calculation	
			Technical Building Code, CTE-DB-HS	https://www.codigotecnico.org/images/st ories/pdf/salubridad/DcmHS.pdf	Ν	CTE-DB-HS1, 2.3.1 and 2.3.2 - The degree of impermeability of the facade must be 2, and its coating must have a medium resistance to filtration.																	
			Regulation of potable water supply and sanitation municipal service (BOPV 26th April 2006)	http://www.valladolid.es/es/ayuntamiento /normativa/abastecimiento-agua-potable- saneamiento-reglamento-servicio	U	Title III – Use of the residual water system: Article 67 Use of sewerage service; Article 69 Liability of the discharge; Article 79 Mandatory use of the network; Article 80 Connection license of sanitation connection; Article 81 Execution of sanitation connections and imputable expenses; Article 82 Conditions prior to connection; Article 83 New sewers; Article 84. Conservation and maintenance.																	
			Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.	http://www.boe.es/boe/dias/2012/09/15/ pdfs/BOE-A-2012-11605.pdf	Ν	[Plants and trees] This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.																	

NBS Code	NBS Group	NBS Description	Regulation	Website	Scale	Requirements									
			Technical Building Code, CTE-DB-SI	https://www.codigotecnico.org/images/st ories/pdf/seguridadIncendio/DccSI.pdf	N	CTE-DB-SI2, 2.3 - The fire reaction rate of materials occupying more than 10% of the exterior finish of the roof shall be BROOF(t1). CTE-DB-SI5, 1.1 - Approach roads of fire truck to manoeuvring spaces shall meet the following conditions: a) free minimum width 3.5 m; b) minimum free height or gauge 4.5 m; CTE-DB-SI5, 1.2 - Buildings with a descending evacuation height greater than 9m must have a space that complies with the following conditions along the façades in which the entrances are located: a) free minimum width 5 m; b) free height, equal to the building.									
	Horizontal green interventions		Technical Building Code, CTE-DB-SE1	https://www.codigotecnico.org/images/st ories/pdf/seguridadEstructural/DBSE.pdf	Ν	CTE-DB-SE1, 4.4- It is considered that there is sufficient strength of the supporting structure, of a structural element, section, point or of a union between elements, if for all the relevant dimensioning situations the following condition is fulfilled: $Rd \leq Ed$ ; $Ed$ : calculation value of loads; $Rd$ : value of resistance calculation.									
VAc27 VAc28 VAc29		Green covering shelter; Green roof;	Technical Building Code, CTE-DB-HS	https://www.codigotecnico.org/images/st ories/pdf/salubridad/DcmHS.pdf	Ν	For roofs the required degree of impermeability is unique and independent of climatic factors. Any constructive solution reaches this degree of impermeability if it fulfills the indicated conditions in 2.4.2 – 2.4.3 and 2.4.4.									
		Green shady structures	Royal Decree 1628/2011, 14 <sup>th</sup> November, List and Spanish Catalogue of Exotic and Invasive Species (BOE nº 298, 12 <sup>th</sup> Dec 2011)	https://www.boe.es/boe/dias/2011/12/12 /pdfs/BOE-A-2011-19398.pdf	Ν	The plant species used on the NBS can not be on this list (Annex I, Annex II)									
					Regulation of potable water supply and sanitation municipal service (BOPV 26th April 2006)	http://www.valladolid.es/es/ayuntamiento /normativa/abastecimiento-agua-potable- saneamiento-reglamento-servicio	U	Title III – Use of the residual water system: Article 67 Use of sewerage service; Article 69 Liability of the discharge; Article 79 Mandatory use of the network; Article 80 Connection license of sanitation connection; Article 81 Execution of sanitation connections and imputable expenses; Article 82 Conditions prior to connection; Article 83 New sewers and Article 84. Conservation and maintenance.							
			Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.	http://www.boe.es/boe/dias/2012/09/15/ pdfs/BOE-A-2012-11605.pdf	Ν	[Plants and trees] This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.									
			Public lighting regulations of Valladolid	Pending/Unknown	U	Public lighting conditions.									
			IEC 60529:1989/A2:2013 Degrees of protection provided by enclosures (IP Code). International Electrotechnical Commission	https://webstore.iec.ch/publication/2452	E	Electrical protection.									
			Manual for Wastewater Treatment Systems implantation in small communities (CEDEX & CENTA, 2010)	http://www.centa.es/portfolio- items/manual-la-implantacion-sistemas- depuracion-pequenas-poblaciones/	Ν	Design especifications of horizontal subsurface constructed wetlands.									
VAc26	Electro wetland	Electro wetland	l Electro wetland	P Electro wetland	P Electro wetland	Electro wetland	20 Pr Electro wetland	lectro wetland	Pra lectro wetland	201 Pra lectro wetland	202 Pra ectro wetland	Practical Manual for Wastewater Treatment in small municipalities (CHD, 2013)	http://www.chduero.es/Inicio/PortaldelCiu dadano/Publicaciones/ManualesGu%C3%A DaseInventarios/tabid/585/Default.aspx	Ν	Chapter 5 Wastewater treatment tecnologies aplicable to small municipalities.
			Law 5/1999, 8th April, on Urban planning in Castilla y León	https://www.boe.es/buscar/doc.php?id=B OE-A-1999-12599	R	Art.97 Acts subject to license. Require obtaining urban planning license, without prejudice to other interventions, acts of use of the that exceed the normal use of natural resources.									
			Guide for vegetation in riparian zones of the Cuenca del Duero (CHD, 2008)	http://www.chduero.es/Inicio/PortaldelCiu dadano/Publicaciones/ManualesGu%C3%A DaseInventarios/tabid/585/Default.aspx	R	Chapter IV Acuatic plants.									
			Regulation of potable water supply and sanitation municipal service (BOPV 26th April 2006)	http://www.aguasdevalladolid.com/PDF/R eglamento Valladolid.pdf	U	Title III Use of the sewer system. Annex IIIDdischarge limits to the public sewer system.									
VAc30	Urban garden bio- filter	Urban garden bio- filter	Municipal Regulations for the protection of the atmospheric environment (BOP Valladolid 22/07/1997)	http://www.valladolid.es/es/ayuntamiento /normativa/medio-ambiente-atmosferico- reglamento-proteccion.ficheros/3232- ReglamentoProteccionMedioAmbienteAtm osferico.pdf	U	TITLE IV Industrial Pollution/ TITLE V Miscellaneous activities (Article 43)/ TITLE VI Special Immigration Situations									

NBS Code	NBS Group	NBS Description	Regulation	Website	Scale	Requirements
VAc31	Urban farming	Urban orchard; Community	Decree nº 2369, 7th April 2016, on Bases for the Ecological Gardens Proposals 2016-2017	www.valladolid.es/es/actualidad/noticias/ huertos-ecologicos-2016-2017 https://goo.gl/LV6UG7	U	Criteria for access and use of ecological orchards for the unemployed and community-based orchards (associations). The space ceded will be devoted exclusively to the practice of ecological horticulture; the products will be for self-sufficiency (orchards for unemployed) or for charity (community-based orchards)
VAC32 VAc33	promotion	scale urban livestock	Royal Decree 1311/2012, 14th September, sustainable use of plant protection products.	http://www.boe.es/boe/dias/2012/09/15/ pdfs/BOE-A-2012-11605.pdf	Ν	[Plants and trees] This Directive establishes a framework to achieve a sustainable use of pesticides by reducing the risks and impacts of pesticide use on human health and the environment and promoting the use of integrated pest management and of alternative approaches or techniques such as non-chemical alternatives to pesticides.
VAc34	Educational	Educational paths	Environmental Education Strategy in Castilla y León (Castilla y León Regional Government, 2003)	http://www.valladolid.es/es/ciudad/consumo/s ervicios/educacion-ambiental-desarrollo- sostenible/documentacion.ficheros/14644- EstrategiaEducacionAmbientalCyL.pdf	R	Communication process, commitment and consensus among all the actors of environmental education in Castilla y León.
VAc35 VAc36	activities	farming educational activities	Municipal Environmental Education Program (Local Agenda 21)	www.valladolid.es/es/ciudad/medio-ambiente- salud/servicios/educacion-ambiental-desarrollo- sostenible/programas-actividades-dirigidas- poblacion-general/programa-municipal- educacion-ambiental	U	Addressing the environmental problems generated by our model of life - fundamentally urban - and the human problems derived from these environmental impacts, through speeches, courses and guided visits.
		Engagement Portal for citizen; Promotion of ecological reasoning and intelligent; Single desk for RUP deployment; City mentoring strategy (Staff Exchange activities)	Law 19/2013, of 9th December, on Transparency, Access to public information and Good governance.	www.boe.es/boe/dias/2013/12/10/pdfs/B OE-A-2013-12887.pdf	Ν	The Autonomous Communities and Local Entities will have a maximum period of two years to adapt to the obligations contained in this Law (2015)
VAc37 VAc39 VAc40	Promotion of NBS		Law 37/2007, of 16th November, on the Re-use of information from the public sector (Modified by Law 18/2015, of 9th July)	www.boe.es/buscar/pdf/2007/BOE-A-2007- 19814-consolidado.pdf www.boe.es/boe/dias/2015/07/10/pdfs/B OE-A-2015-7731.pdf	Ν	The reuse of the information generated by Local Entities has the fundamental objective of the creation of public value in society, in the following areas: Social (right of access to public sector information and knowledge), Innovative (for commercial or non-commercial purposes) and Economic (impact on economic growth and job creation).
Vac42			Ordinance on Transparency, Access to information and its Reuse (BOPV n° 214, de 16th September 2016)	http://www.valladolid.es/es/ayuntamiento/nor mativa/transparencia-acceso-informacion- reutilizacion-ordenanza.ficheros/341162- TRANSPARENCIAINFORMACIONREUTILIZACION ORD.pdf	U	Systems to integrate the management of citizens requests for information, through information technoligies (IT). Promotes bidirectional communication, with effective citizens participation in the processes of decision, collaboration and control of the Administration. Article 19. Information on contracting, agreements and subsidies (contract, object, amount, duration, procedure, instruments, number of tenderers, successful tenderer)
VAc38 VAc41	Support and sponsoring activities	Sponsoring activities; Support to citizen project of NBS	n/d	<u>n/d</u>	n/d	n/d

#### D2.2 Annex III. Challenges and limitations

N/A: not applicable.

					Challenges and Limitations' Categories						
NBS Code	NBS Group	NBS Description	Public management	Administrative	Technical	Economical	Environmental	Social			
42 actions in Valladolid	NBS type by nature	NBS included	e.g Implementation process, public procurement, tenders, direct installation by a private	e.g Public and private permitting plan, communication to the citizens	e.g Design, construction, implementation process, materials,	e.g High cost, lack of funding,	e.g Weather conditions, timing (proper year season)	e.g Vandalism, poverty,			
VAc1 VAc6 VAc15	New green cycle lane and re-naturing existing bike lanes	Green cycle lane; Green resting areas; Cycle- pedestrian green paths	<ul> <li>Slow periods for public tendering and processing.</li> <li>Possible lack of ordinaces and local regulations.</li> </ul>	<ul> <li>Coordination with the City Council Áreas responsible for the current construction and management of the Valladolid Cyle Iane (Urbanism and Environment) and Parks and Gardens (Environment).</li> <li>PIMUSSVA participative process: participa@pimussva.es.</li> <li>Pest and vegetation disease control requires Administrative authorization.</li> </ul>	<ul> <li>Lack of space in the public road for the construction of the cycle lane.</li> <li>Only biological products and biological control can be used in public spaces.</li> </ul>	Expected cost might not cover the initial km planned, so it might have been infradimensioned.	<ul> <li>For the vegetation, there are rules of use depending on weather conditions and infestation degree of the pest or disease.</li> </ul>	<ul> <li>Difficulties in the coexistence of the pedestrian with the cyclist in crossing areas and in cycle-streets.</li> <li>For the vegetation, high toxicity products are banned.</li> </ul>			
VAc2 VAc3 VAc4 VAc5 VAc7	Tree related actions	Planting 1,000 trees; Tree shady places; Shade and cooling trees; Re-naturing parking trees; Urban Carbon Sink	<ul> <li>Slow periods for public tendering and processing.</li> <li>Possible lack of ordinaces and local regulations.</li> <li>Responsibility for maintenance.</li> </ul>	Delays in the project deployemnt: • Coordination with the City Council Áreas responsible for the control (Parks and gardens). • Public permits to occupy the public thoroughfare, if applies. • Pest and vegetation disease control requires Administrative authorization. • Lack of correspondence between the Project and the Political agenda.	<ul> <li>Existence of installed facilities (water pipes, electric cables), that can interfere in the proper execution of the actions planned.</li> <li>Selected trees must foster local biodiversity, thus local and not allergenic species must be prioritized. It must be considered that trees roots growth might have negative impact towards different pavements (streets, roads and sidewalks).</li> <li>To control pest and vegetation diseases phytosanitary product must be applied, but only biological products and biological control can be used in public spaces.</li> </ul>	<ul> <li>In order to guarantee the eveluation of the foreseen NBS, grown trees must be planted. This might result in an increase in cost per tree planted, so it might affect the initial budget or the number of trees per NBS.</li> <li>Possible pests might affect the planted trees, which shall be replaced, resulting in a non considered increase in budget.</li> </ul>	<ul> <li>Rules of use depending on weather conditions and infestation degree of the pest or disease.</li> <li>Selection of autochthonous and nonallergenic species.</li> <li>Regulations regarding the application of phytosanitary products as function of the weather conditions and the infestation degree can become and environmental limitation.</li> <li>Also the climatologic constraints can affect NBS proper deployment.</li> <li>Best time to plant: spring or autumn. Seasonality might condition the most suitable planting timeframe, which might not coincide with the project chronogram.</li> </ul>	<ul> <li>Selected trees must have no negative health effect in terms of allergenic agents released to atmosphere.</li> <li>Bird flocks in tree areas might cause noise disturbance and negatively affect the cleanliness of the surrounding public area.</li> <li>Vandalism.</li> <li>High toxicity products are banned.</li> </ul>			
VAc8 VAc9	SUDs	SUDs for green bike lane; SUDs for re- naturing parking	<ul> <li>Slow periods for public tendering and processing.</li> <li>Possible lack of ordinaces and local regulations.</li> </ul>	<ul> <li>Coordination with the City Council Áreas responsible for the current construction and management of the Valladolid Cyle lane (Urbanism and Environment).</li> </ul>	<ul> <li>Few construction companies with demonstrated experience in the construction of SUDs in the local area.</li> <li>Lack of space for the construction of the 50m2-SUDs foreseen in the Urban Green UP proposal.</li> <li>The permeability of the soil addressed to the SUDs does not guarantee the filtration of the run-off water.</li> </ul>	NA	NA	Possible acts of vandalism as they are not restricted areas. Wastes accumulation			
VAc13	Natural Wastewater Treatment Plant	Natural Wastewater Treatment Plant (NWTP)	<ul> <li>Slow periods for public tendering and processing;</li> <li>The authorisation for water discharge and later water reuse can take a long time.</li> <li>Possible lack of ordinaces and local regulations.</li> </ul>	CHD must approve the authorisation for the new water discharge point and for using the reclaimed water for irrigation in the park. This administrative procedure must be led by Valladolid City Council.	<ul> <li>Connection to the city sewarage to conduct water to the natural WWTP may be a problem. This connection must guarantee a constant volume to the natural park although this NBS show certain robustness against fluctuations (in hydraulic load);</li> <li>Few construction companies with demonstrated experience in the construction of natural WWTP in the local area.</li> </ul>	Expected cost does not cover the connection of the city sewarage to the natural WWTP.	Emission of CH4 and other GHG in the primary treatment (septic tank or Imhoff tank). Sewage sludge production (although samll) will need a proper management.	Incompatibilitites between the natural WWTP and the recreative uses in the park. Restricted access to the Natural WWTP (fenced area). Potential bad odours associated to the primary treatment.			
VAc10	Rain gardens	Rain gardens	Slow periods for public tendering and processing;     Few construction companies with demonstrated experience in the construction of rain gardens in the local area.	<ul> <li>Coordination with the City Council Áreas responsible for the control (Parks and gardens).</li> <li>Pest and vegetation disease control requires Administrative authorization.</li> </ul>	<ul> <li>Few construction companies with demonstrated experience in the construction of rain gardens in the local area.</li> <li>The permeability of the soil addressed to the SUDs does not guarantee the filtration of water</li> <li>Only biological products and biological control can be used in public spaces.</li> </ul>	NA	<ul> <li>Rules of use depending on weather conditions and infestation degree of the pest or disease.</li> </ul>	<ul> <li>Possible acts of vandalism as they are not restricted areas.</li> <li>Wastes accumulation.</li> </ul>			

NBS Code	NBS Group	NBS Description	Public management	Administrative	Technical	Economical	Environmental	Social
VAc12	Green filter area	Green filter area	<ul> <li>Slow periods for public tendering and processing.</li> <li>Few construction companies with demonstrated experience in the construction of green filters in the local area.</li> </ul>	CHD must approve the authorisation for the new water discharge point and for using the reclaimed water.	<ul> <li>Few construction companies with demonstrated experience in the construction of green filters in the local area.</li> <li>Lack of space for the construction of the green filter.</li> <li>The water captation after the filtration thorugh the soil may be complicated (different solutions must be studied: water well, draiange system)</li> </ul>	NA	NA	NA
VAc11	Floodable park	Floodable park	<ul> <li>Slow periods for public tendering and processing.</li> <li>Possible delays due to some missing administrative tender document or processing issues.</li> </ul>	<ul> <li>Coordination with other partners responsible of the design and implementation of other NBS located in the floodable park to ensure a correct integration between all of them.</li> <li>Need to fulfill an established schedule with milestones and deliverables.</li> </ul>	<ul> <li>Existence of an electric line crossing the plot where it is going to be located the floodable park. • To ensure that the retention pond is gradually emptied after an episode of flooding. • To calculate exactly the height of the spillway so that it begins to derive part of the water flow in the moment just before the water starts flooding throughout some zones of the city of Valladolid and might produce adverse consequences for human health, cultural heritage and economic activity. • To solve how to illuminate the park in the floodable zone. • The surface of the plot might be not big enough to store the required volume of water. • Since there no exists water supply system in the floodable park area, there is a need to solve how to irrigate green zones, plants and trees of the park.</li> </ul>	<ul> <li>The needed budget to carry out the works required for a proper design of the floodable park and its auxiliary elements is expected to be higher than the available budget.</li> <li>No tenderer submits a valid economic offer to the bidding process.</li> </ul>	• Lack of knowledge about the level of the water table. • Need to develop a study regarding the permeability of the ground in order to know how the water can flow beneath the surface when the pond is storing water.	<ul> <li>To keep a proper level of maintenance of the park optimizing both human and economic resources.</li> <li>To face possible problems of vandalism.</li> <li>To control and forbid access to the park while the retention pond is storing excess water from floods.</li> <li>To explain adequately to the citizens the purpose and function of the floodable park.</li> </ul>
VAc14	Green Parking Pavements	Green parking pavements	<ul> <li>It is recommended a selecting process to evaluate several technical proposals for this concept.</li> <li>Good placement definition.</li> </ul>	<ul> <li>Administrative coordination among the main stakeholders to implement the initiative pushing them to fulfill their responsibilities in time and according to tender timing; an effective and well defined interaction public vs private stakeholders is crucial.</li> <li>A communication plan for citizens will be developed explaining them the advantages of the system and use this facility.</li> </ul>	To define an innovative plan that permits to reduce or mitigate the losses of service on parking áreas while the adaptation works are on-going.	Although it is possible that the initial solution is not expensive, the maintenance of it could be. It is important to define a long term costs plan to evaluate this.	Environmental concerns about the use of green pavements, diversity in dense urban structure: Is the solution of this system robust for every year season?. Does it work only in warm and sunny weather?. How is it affected in rainy places?	Green solutions must be resilient to moderate-strong mechanical impacts and common chemical products (graffiti paintings, medium-strong corrosive liquids: 2 <ph<10 low="" or="" voltage<br="">discharge Vpp &lt; 1000V). Mantainance issue, may happen that the number of the parking volume is going to be less.</ph<10>
VAc16 VAc17 VAc18	Smarts soils as substrate	Smarts soils for cycle- pedestrian paths (A); for green singular infrastructure (B); in NWTP zone (C)	Residues used for the preparation of substrates require authorization by LER code https://www.boe.es/diario_boe/t xt.php?id=BOE-A-2002-3285	Coordination with the City Council Áreas responsible for the current construction and management of the Valladolid Cyle lane (Urbanism and Environment).	A high number of smart soils needed at certain times of the year can be limiting.	NA	NA	Possible presence of odours.
VAc19 VAc20 VAc21	Pollinators modules	Natural pollinator's modules (A, C); Compacted modules (B)	Natural Pollinator's modules instalation depends on other implementations.	<ul> <li>Coordination with the City Council Áreas responsible for the instalation (Urbanism and Environment).</li> <li>Compacted Pollinator's modules requires Administrative authorization.</li> </ul>	Lack of space in the public streets or spaces for their instalation.	NA	Preferable installation in wintertime.	Required Social Awareness Avoid Vandalism Not disturbing social events
VAc22 VAc23 VAc24 VAc25	Vertical green interventions	Green noise barriers; Green vertical mobile garden; Green façade	<ul> <li>Slow periods for public tendering and processing</li> <li>Responsibility for maintenance</li> </ul>	<ul> <li>Public permits to occupy the public thoroughfare</li> <li>Private permits to affix green infrastructures to façades</li> <li>Pest and vegetation disease control requires Administrative authorization.</li> </ul>	<ul> <li>Low resistance of the existing façades.</li> <li>Material storage space during construction.</li> <li>Space for irrigation facilities.</li> <li>Only biological products and biological control can be used in public spaces.</li> </ul>	Cost of maintenance	<ul> <li>Rules of use depending on weather conditions and infestation degree of the pest or disease.</li> <li>Best time to plant: spring or autumn.</li> </ul>	<ul> <li>Disagreement with the project, of some citizen.</li> <li>Vandalism.</li> <li>High toxicity products are banned.</li> </ul>

NBS Code	NBS Group	NBS Description	Public management	Administrative	Technical	Economical	Economical Environmental	
VAc27 VAc28 VAc29	Horizontal green interventions	Green covering shelter; Green roof; Green shady structures	<ul> <li>Slow periods for public tendering and processing</li> <li>Responsibility for maintenance</li> </ul>	<ul> <li>Coordination with the City Council Áreas responsible for the control (Parks and gardens).</li> <li>Public permits to occupy the public thoroughfare</li> <li>Private permits to affix green infrastructures to façades</li> <li>Pest and vegetation disease control requires Administrative authorization.</li> </ul>	<ul> <li>Design of the foundation and fixation in relation to the construction site.</li> <li>Low resistance of the existing roof.</li> <li>Material storage space during construction.</li> <li>Space for irrigation facilities.</li> <li>Only biological products and biological control can be used in public spaces.</li> </ul>	Cost of maintenance	<ul> <li>Rules of use depending on weather conditions and infestation degree of the pest or disease.</li> <li>Best time to waterproof: summer.</li> </ul>	<ul> <li>Disagreement with the project, of some citizen.</li> <li>Vandalism.</li> <li>High toxicity products are banned.</li> </ul>
VAc26	Electro wetland	Electro wetland	<ul> <li>Slow periods for public tendering and processing.</li> <li>The company in charge of Valladolid wastewater treatment became public (property of the municipality) last year. This could derive in problems having acces to wastewater characteristics information that would potentially have the private enterprise.</li> </ul>	<ul> <li>Delays due to lack of coordination between local political agenda and project chronogram. Also internal coordination issues among municipality working areas (urbanism, gardening and innovation agency) can generate project execution delays.</li> <li>Delays due to permissions and validations of civil works in public spaces approved by municipality actors.</li> </ul>	<ul> <li>The connection of the NBS with the sewage system was not fully detailed in the project proposal. So, the ubication of the NBS is still in a decision process.</li> <li>Issues related to wastewater composition, flows, public space ocupation have to be agreed between Leitat and Valladolid City Council. This might result in delays in NBS deployment.</li> <li>It might be difficult to select an aquatic plant specie that fits the electrowetland requirements and adapts to climate condition constrictions in Valladolid.</li> </ul>	The lack of information of ubication and wastewater composition can result into changes of the NBS design. This includes the potential need of a primary treatment as well as additional pumping systems (not initially contemplated in the budget). Thus, EW surface might differ from the initial proposal.	<ul> <li>The electrowetland construction will boost urban biodiversity by opening a new green area that might attract different fauna. This change in urban fauna in the city shall be contemplated by the municipality responsibles.</li> <li>Risks of plant decay during winter.</li> </ul>	<ul> <li>The plant decay during wintertime can negativelly affect the green area beauty. This might decrease public acceptance of the electrowetland.</li> <li>The acces to the NBS will be forbidden to the general public due to the presence of urban wastewater within the treatment bed.</li> </ul>
VAc30	Urban garden bio-filter	Urban garden bio-filter	It is recommended a selecting process having in mind the innovative character of the solution. Definition of the placement for the application	Coordination with the city council for the appropiate licenses/authorizations. Pest and vegetation disease control requires Administrative authorization.	<ul> <li>Adequation of the solution to the selected area.</li> <li>Evaluation of air flows.</li> <li>Safe area consideration and clearly defined zone for the measurement system (not accesible).</li> <li>Only biological products and biological control can be used in public spaces.</li> </ul>	Expected cost different from the expected due to the final location. Mantainance costs.	Environmental concerns about the use of waste within the materials.	Vandalism during execution and monitoring, social acceptance of the initiative
VAc31 VAc32 VAc33	Urban farming promotion	Urban orchard; Community composting; Small-scale urban livestock	<ul> <li>Coordinated management with the current urban orchards of the city (Echological orchards 2016- 2017)</li> <li>Responsibility for maintenance</li> </ul>	It is pendig to determine who exploits them (unemployed / retired / social exclusion / all).	Valladolid municipal orchards will be devoted exclusively to the practice of ecological horticulture.	Calculate real implementation cost to solve it with municipal budget.	Inauguration of the orchards in a year period which can begin its exploitation.	<ul> <li>Lack of citizens available for the operation and maintenance of urban gardens.</li> <li>The orchards users must agree a series of ethical commitments.</li> </ul>
VAc34 VAc35 VAc36	Educational activities	Educational paths (A, C); Urban farming educational activities	Their instalation depends on other implementations.	Coordination with environmental education plans (Department of Environment)	NA	Calculate real implementation cost to solve it with municipal budget.	NA	<ul> <li>High toxicity products are banned.</li> </ul>
VAc37 VAc39 VAc40 Vac42	Promotion of NBS at citizen scale	Engagement Portal for citizen; Promotion of ecological reasoning and intelligent; Single desk; City mentoring strategy	<ul> <li>Its set-up depends on the rest of the implementations/actions.</li> <li>Limitations in the program of bonuses / incentives for citizen participation.</li> </ul>	<ul> <li>Interaction with other municipal applications (Citizen Observatory)</li> <li>Portal connection to App "Valladolid in my pocket"</li> </ul>	Lack of current data available for the calculation of KPIs and communication to citizens.	Calculate real implementation cost to solve it with municipal budget.	NA	• Citizens do not know what NBS and GI are.
VAc38 VAc41	Support and sponsoring activities	Sponsoring activities; Support to citizen project of NBS	Its set-up depends on the rest of the implementations/actions.	Identify the actors involved in support and soponsoring activities in agreement with the council.	NA	Calculate real implementation cost to solve it with municipal budget.	NA	NA

#### D2.2 Annex IV. NBS - KPI - Data

					KPI's		Dat	a already available		Data expected in URE	BAN GreenUP	Observations	
NBS	NBS Group	NBS	Eklipse	Type of	KPI Definition	KPI unit	Data source	Website	Data values	Data source	Data values	Observations	
Code 42		Description NBS included in each	challenge	indicator		Unit annual colored to				Data source expected in URBAN GreenUP	Executed values are as former	Comments, annotations, considerations	
actions in	NBS type by nature	group / Sub-Demo	to 10	Type of indicator	KPI description	unit proposed, related to measure method	Data source already available	Link to the data source	baseline	(instalation of sensors for monitoring, expected	Expected values, ranges, forecast, measure method	e.g. data unailable, imposibility to get,	
Vəllədolid		site (A_B_C)	CHALLENGE 1: Climate mitigation & adaptation	CO <sub>2</sub> eq. Emissions Avoided	CO <sub>2</sub> eq emissions avoided considering a life cycle approach and modelling the environmental impacts regard to indirect savings.	(tCO2eq p/year	- IPCC 2013 GWP 2010a methodology. Considering a life cycle approach and modelling the environmental impacts regard to indirect savings. - Standard Emisions factor in line with the IPCC principles.	<u>- Comercial Software SimaPro*</u> <u>-</u> <u>http://www.covenantofmayors.eu/</u> <u>about/signatories_en.html?city_id</u> <u>=27488seap</u>	Value estimated for the proposal preparation. 212 tCO2eq p/year Baseline SEAP Valladolid 2010. Total Transport emissions in the city. 2020 21 CO2 emichant (b)	Collected data about users and uses during the project. IPCC 2013 GWP 2010a methodology. Considering a life cycle approach and modelling the environmental impacts regard to indirect savings.		(CAR] CARTIF has the expertise to define and calculate this KPI.	
			CHALLENGE 2: Water Management	Physical indicators	Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	Armson, D., Stringer, P., & Ennos, A. R. (2013). The effect of street trees and amenity grass on urban surface water runoff in Manchester, UK. Urban Forestry and Urban Greening. 12(3), 282–286.; Spanish State Meteorological Agency.	http://www.sciencedirect.com.recu rsos.biblioteca.upc.edu/science/art icle/pii/S1618866713000460; https://datosclima.es/Aemet2013/ Tempestad2013.php	Change (asphalt -> tree) in runoff coeficient (winter): 0,6 -> 0,25 (aprox); Change (asphalt -> tree) in runoff coeficient (summer): 0,55 -> 0,20 (aprox); Precipitation in Valladolid (2016) = 448 I/m2	Urban green up estimation stated in the proposal	UrbanGreenUp project plans to plant 3850 trees within the city through this actions. According to the increase in drainage surface (33100 m2) a bioretentio capacity of 150 l/m2 is expected.		
					Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Local Agenda 21 of Valladolid - Sustainability indicators	www.valladolidagendalocal21.es	Percentage of citizens living within 500 m of a public green area (with an area > 5,000 m2) = $96.06\%$ (2014)	Calculated throug Valladolid Population distribution and NBS locations (in terms of distance and time)	n/d	[VAL] Valladolid City Council can calculate this KPI.	
				Social indicators (benefits)	Weighted recreation opportunities provided by Urban Green Infrastructure.	(nº recreational areas)	Environmental Services - Environment Ministry. Valladolid City Council						
	New green	Green cycle			Distribution of public green space – total surface or per capita.	(km <sub>cycle lane</sub> /capita)	Mobility. Valladolid City Council		Kilometers <sub>cycle lane</sub> per capita =				
VAc1	cycle lane and	lane; Green	CHALLENGE 4:		Increased connectivity to existing GI	(% increased km ovie lane)	Mobility. Valladolid City Council		% increased km corte lane =				
VAc6	re-naturing	resting areas;	Green Space Management			cycle lanes			Circle tarile				
VAc15	existing bike	Cycle- pedestrian		Environmental	Sustainability of green areas - Vallabici (public cycle leasing service)	(annual subscriptions) (uses)	Comprehensive Urban, Sustainable and Safe Mobility Plan for the City of Valladolid (PIMUSSVA)	www.pimussva.es	Vallabici: 2,177 users (2015) Vallabici: 476 uses (2015)				
	lanes	green paths		(biological)	Quality of life for elderly people	Survey	No data found to define the baseline			Surverys developed in the URBAN GreenUP Android mobile application (App): Identify Social perception, wellbeing	Satisfaction measure		
					Perceptions of connectivity and mobility.	Survey	No data found to define the baseline			Surverys developed in the URBAN GreenUP Android mobile application (App)	Satisfaction measure		
			CHALLENGE 5: Air Quality	Environmental (chemical)	Air quality parameters NOx, VOC, PM etc - Emissions avoided due to bicycle use	(kg CO <sub>2</sub> /km car)	Valladolid City Council Air Pollution Control Network (RCCAVA)	www.valladolid.es/es/rccava/datos- red/datos-actualizados-temporales	224,265.33 kg CO <sub>2</sub> avoided Average factor Kg CO2/Km car = 0.168 (IDAE)				
		1		Urban green	Accessibility: distribution, configuration, and diversity of green	(km road subtitution by	Mobility. Valladolid City Council		km cycle lane over roads =				
		I	CHALLENGE 6:	Indicators	Savings in energy use due to improved G	(savings   diesel)							
		I	Regeneration	Socio-cultural		()	Commentancius Uniter Containable and Cafe Mathility						
		I		Indicators	and post interventions	(km cycle/km road)	Plan for the City of Valladolid (PIMUSSVA)	www.pimussva.es					
			CHALLENGE 9: Public Health and Well-being	Health indicators	Increase in walking and cycling in and around areas of interventions.	(users) (bicycles)	Mobility. Valladolid City Council		nº cyclist =		nº green corridor uses =		
				Carbon savings per unit area (environmental, chemical) Carbon storage	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(ton CO2/Ha) (ton CO2/year) (ton)	Census of trees and brushes in Valladolid. Guide to estimate Carbon Dioxide absorptions (Spanish Office of Climate Change. Ministry of Agriculture and Environment)	Link to the data source	Value estimated for the proposal preparation: 45,68 tCO2eq p/year Baseline data not yet calculated. Data collection and calculations in progress.	Census of trees and brushes in Valladolid. Guide to estimate Carbon Dioxide absorptions (Spanish Office of Climate Change. Ministry of Agriculture and Environment)	Vac7 will sequestrate carbon dioxide equivalent to 16,5 t/year.Vac 2,3,4,5 will suppose sequestration of 29.18tCO2 eq./year due trees activity.	[CAR] CARTIF has the expertise to define and calculate this KPI.	
			CHALLENGE 1: Climate mitigation & adaptation	1: igation n (environmental, physical)	Decrease in mean or peak daytime local temperatures (°C)	(°C)	Spanish State Meteorological Agency	https://datosclima.es/Aemet2013/ Tempestad2013.php	Temperature record from May 2013	Urban green up estimation stated in the proposal	Vac7 will reduce ambient temperature in 2°C. Vac 2,3,4,5 will reduce temperature 2-4 °C	[LEI] No specific data from the NBS location available	
					Heatwave risks (number of combined tropical nights (>20 °C) and hot days (>35 °C)	(nº days)	Spanish State Meteorological Agency	https://datosclima.es/Aemet2013/ Tempestad2013.php	Temperature record from May 2013	Urban green up estimation stated in the proposal	Vac7 will reduce ambient temperature in 2°C. Vac 2,3,4,5 will reduce temperature 2-4 °C	[LEI] No specific data from the NBS location available	
		1		Others	Use of Star tools to calculate projected maximum surface	(°C)				Star tools (projected temperature reduction)			
					temperature reduction (°C) Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)	Armson, D., Stringer, P., & Ennos, A. R. (2013). The effect of street trees and amenity grass on urban surface water runoff in Manchester, UK. Urban Forestry and Urban	http://www.sciencedirect.com.recu rsos.biblioteca.upc.edu/science/art icle/pii/S1618866713000460;	Change (asphalt> tree) in runoff coeficient (winter): 0,6> 0,25 (aprox); Change (asphalt> tree) in runoff	Urban green up estimation stated in the proposal	Vac7 will generate 30000 m2 of drainage surface; Vac 2,3,4,5 will generate 3100		
				R	Ri			Greening, 12(3), 282–286. ; Spanish State Meteorological Agency Armson D. Stringer P. & Ennos A. B. (2013). The	https://datosclima.es/Aemet2013/ Tempestad2013.php	coeficient (summer): 0,55> 0,20 (aprox); Change (asphalt -> tree) in runoff		m2 of drainage surface; UrbanGreenUp project plans to plant	
					Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	Effect of street trees and amenity grass on urban surface water runoff in Manchester, UK. Urban Forestry and Urban Greening, 12(3), 282–286. ; Spanish State Meteorological Agency	http://www.sciencedirest.com.recu rsos.biblioteca.upc.edu/science/art icle/pii/S1618866713000460: https://datosclima.es/Aemet2013/ Tempestad2013.php	coeficient (winter): 0,6> 0,25 (aprox); Change (asphalt> tree) in runoff coeficient (summer): 0,55> 0,20 (aprox); Precipitation in Valladolid (2016) = 448	Urban green up estimation stated in the proposal	3850 trees within the city through this actions. According to the increase in drainage surface (33100 m2) a bioretention capacity of 150 L/m2 is ownerded		
			CHALLENGE 2	indicators	Areas (Ha) and population (inhab) exposed to flooding	(Ha) (inhab)	National Flood Zone Mapping System	http://sig.mapama.es/snczi/visor.h tml		Flood models should be developed to study the effect of the floodable park with respect the current situation	n/d	[VAL] Confederación Hidrográfica del Duero might help to calculate this KPI.	
		1	Water		Flood peak reduction (lacob et al., 2014),	(%)	Caumax (Map of maximum flows in natural regime)	http://sig.mapama.es/snczi/visor.h			n/d		
			Management		Reduction of drought risk (probability).	(probability)							
					Intercepted rainfall (m3 year-1)	(m3 year-1)	Aemet (State Agency of Meteorology)	http://www.aemet.es/es/portada	Precipitations in Valladolid	Regulating urban surface runoff through nature-based solutions - An assessment at the micro-scale.	Expected 60% of rainfalls could be captured by green surfaces and bioretentions strucures		
		1			Share of green areas in zones in danger of floods (%)	(%)							
		1			Population exposed to flood risk (% per unit area)	(%/m2)							
		in	Chemical indicators (water	Nutrient abatement, abatement of pollutants (%, nutrient load, heavy metals).	Chemical Oxygen Demand (COD) (mg/l); Biochemical Oxygen Demand (BOD) (mg/l); Total Solids (SST) (mg/l)	Manual para la implantación de sistemas de depuración en pequeñas poblaciones ( Ministerio de Medio Ambiente y Aguas de Valladolid, 2010)	http://www.centa.es/portfolio- items/manual-la-implantacion- sistemas-depuracion-pequenas- poblaciones/; http://www.aguasdevalladnlid.com						
		1		quality)	Water for irrigations purposes (m3 ha-1vear-1)	(m3/ha/year)				Water meter	(m3/ha/year)		
		, I				,,					, .,,,		

NBS	NBS Group	NBS	Eklipse	Type of	KPI Definition	KPI unit	Data source	Website	Data values	Data source	Data values	Observations
couc		Diantina 1.000		Social indicators	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Local Agenda 21 of Valladolid - Sustainability indicators	www.valladolidagendalocal21.es	Percentage of citizens living within 500 meters of a public green area (with an area of more than 5,000 m2) = 96.06% (2014)	Valladolid City council will continuously determine the accessibility to green spaces so the effect of URBAN Green Up can be quantified	Tree related actions could be proposed in existing accesible areas but also they could generate new accesible areas, which could result with an increase in the accesibility to urban green spaces.	
VAc2		trees; Tree shady places;		(benefits)	Weighted recreation opportunities provided by Urban Green Infrastructure.	(nº)	No data found to define the baseline			Valladolid City council will continuously determine the increase in recreation opportunities so that URBAN Green Up effect can be quantified		
VAc3	Tree related	Shade and	CHALLENGE 4: Green Space		Distribution of public green space – total surface or per capita.	(m2/capita)	Valladolid in figures (Valladolid en cifras. Valladolid city council)	http://www.valladolidencifras.es	16,9 m2/capita (2016)		With UrbangreenUp data, it is expected that green spaces per capita will increase	
VAc5	actions	Re-naturing	wanagement		Pollinator species increase (number)	(nº) (%)	No previous data.	<u>n/d</u>	n/d	Methodology and data collection in comming months.	n/d	
VAc7		parking trees;			Increased connectivity to existing GI	(km or Ha <sub>conected trees</sub> )	No previous data.			Methodology and data collection in comming months (GIS technologies)		[VAL] Valladolid City Council can calculate this KPI.
		Sink		(biological)	Sustainability of green areas	(Not defined yet)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 1.es/	<u>2</u> Resources intended for sustainable development over total budget (%): 43%			[LEI] Other units to quantify this KPI should be considered
					Quality of life for elderly people	Survey	No data found to define the baseline			Surverys developed in the URBAN GreenUP Android mobile application (App): Identify Social perception, wellbeing	Satisfaction measure	
					Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted) concentration recorded ug/m3	(µg/m3) PM2.5 (µg/m3) PM10	Valladolid City Council Air Pollution Control Network (RCCAVA)	http://www.valladolid.es/es/rocava /datos-red	<sup>3</sup> РМ10: 17 µg/m3 (2016); РМ2,5: 15 µg/m3	Baró et al., 2014; Baumgardner et al., 2012; Bottalico et al., 2016. Also, RCCAVA will continuously measure air quality so the effect of UrbanGreenUp will be quantified.	The effect of the urban forest on air quality accounts only for a small percentage (around 2%) of the overall concentration of PM10 in cities	
					Trends in emissions SOX	(µg/m3) SO <sub>2</sub>	Valladolid City Council Air Pollution Control Network (RCCAVA)	http://www.valladolid.es/es/rccava /datos-red	<sup>a</sup> Maximum value SO <sub>2</sub> , year 2016: 34 µg/m3	RCCAVA will continuously measure air quality so the effect of Urban GreenUp will be quantified.		
				Environmental	Trends in emissions NOX	(µg/m3) NO (µg/m3) NO2	Valladolid City Council Air Pollution Control Network (RCCAVA)	http://www.valladolid.es/es/rocava /datos-red	NO <sub>2</sub> Maximum value per hour, year 2016: 191 µg/m3	IPCC2013 GWP 2010a methodology (considering a life cycle approach by modelling the environmental impacts of the use of the private car). Also, RCCAVA will continuously measure air quality so the effect of UrbanGreenUp will be quantified.	<ul> <li>Vehicle reactive organic gas evaporative emissions could be reduced by 2% and NOX start emissions by less than 1% (which means that 70% of NOX could be reduced)</li> </ul>	
			CHALLENGE 5:	(chemical) NGE 5: lity	Trends in emissions CO	(mg/m <sup>3</sup> )	Valladolid City Council Air Pollution Control Network (RCCAVA)	http://www.valladolid.es/es/rocava /datos-red	<u>a</u> CO Maximum value per hour, year 2016: 2 mg/m3	RCCAVA will continuously measure air quality so the effect of UrbanGreenUp will be quantified.		
			Air Quality		Annual mean levels of Benzene C <sub>6</sub> H <sub>6</sub>	μg/m3	Valladolid City Council Air Pollution Control Network (RCCAVA)	http://www.valladolid.es/es/rccava /datos-red	<sup>а</sup> year 2016: 0.3µg/m3	RCCAVA will continuously measure air quality so the effect of UrbanGreenUp will be quantified.		
					Concentration of formaldehyde in air.	ppm	No data available			Instalation of sensors for monitoring	Trends in emissions of formaldehyde	
					Annual mean levels of Xylene C6H4 (CH3) <sub>2</sub>	µg/m3	No data available			Instalation of sensors for monitoring	Annual mean levels of Xylene C6H4 (CH3)2	
					Quality air index (ICA)	ICA	Valladolid City Council Air Pollution Control Network (RCCAVA)	http://www.valladolid.es/es/rocava /datos-red	3			[VAL] Air quality indicador calculated by Valladolid City Council
				Economic	Monetary values: value of air pollution reduction; total monetary value of urban forests including air quality, run-off mitigation, energy savings, and increase in property values. use of GI val to calculate the value of air quality improvements	(€)						[LEI] WP7 aims at monetizing the effect of NBS implementation
			CHALLENGE 7: Participatory		Perceptions of citizens on urban nature - Green spaces quality	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 1.es/	Percentage of population satisfied or very 2 satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65%, recordingly	Surverys developed in the URBAN GreenUP Android mobile application (App): Identify Social perception, wellbeing	Satisfaction measure	
		Planning and Governance	Social	Openness of participatory processes (Frantzeskaki and Kabisch, 2016; Luyet et al., 2012; Uittenbroek et al., 2013).	(nº processes) (population)	Valladolid city council (2017)	www.valladolid.es	open processes= 7 ; population= all population above age of 16	Valladolid City council will continuously determine the number of open processes for public participation so that we can measure urban green up effects.	Tree related open processes measure		
			CHALLENGE 9: Public Health and Well-being	Health indicators	Increase in walking and cycling in and around areas of interventions.	(users) (bicycles)	Mobility. Valladolid City Council	www.valladolid.es	users = 54% of the journeys were walking or in bycicle	URBAN GreenUP estimation	It is estimated that than 200,000 citizens per year will use this transports through tree related zones	
			CHALLENGE 10: Potential of	Economic	New businesses attracted and additional business rates (Eftec, 2013).	(business)	Valladolid City Council	www.valladolid.es	Number of buisnesses in the city as function of the economical sector to which they balang	Valladolid City council will continuously determine the number new business so that we can measure urban group up effects	<sup>2</sup> number of new business attracted because of tree related actions	
			economic opportunities	Continue	Number of jobs created; gross value added	(jobs) (GDP)	Valladolid City Council	www.valladolid.es	Number of jobs in public gardening	Parks and gardens Department (Valladolid City	Number of new jobs	

NBS	NBS Group	NBS	Eklipse	Type of	KPI Definition	KPI unit	Data source	Website	Data values	Data source	Data values	Observations
Code		Description	CHALLENGE 1: Climate mitigation & adaptation	Carbon savings per unit area (environmental, chemical) Carbon storage	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(ton CO2/Ha) (ton CO2/year) (ton)	Census of trees and brushes in Valladolid. Guide to estimate Carbon Dioxide absorptions (Spanish Office of Climate Change. Ministry of Agriculture and Environment)	Link to the data source	Value estimated for the proposal preparation: 14,24 tCO2eq p/year	Census of trees and brushes in Valladolid. Data collected during the project. Guide to estimate carbon dioxide absorptions (in Spanish) (Spanish Office of Climate Change. Ministry of Agriculture and Environment)	n/d	[CAR] CARTIF has the expertise to define and calculate this KPI.
		SUDs for	CHALLENGE 2:	Physical	Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)	Bibliography; Spanish State Meteorological Agency	http://www.sciencedirect.com.rec rsos.biblioteca.upc.edu/science/ar icle/pii/S1618866713000460; https://datosclima.es/Aemet2013 Tempestad2013.php	Change (asphalt> tree) in runoff t coeficient (winter): 0,6> 0,25 (aprox); Change (asphalt> tree) in runoff coeficient (summer): 0,55> 0,20 (aprox);	Urban green up estimation stated in the proposal	VAc8 and Vac 9 will generate 500 m2 of drainage surface	
VAc8 VAc9	SUDs	lane; SUDs for re-naturing parking	Water Management	indicators	Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	Bibliography; Spanish State Meteorological Agency	http://www.sciencedirect.com.rec rsos.biblioteca.upc.edu/science/ar icle/pii/S1618866713000460; https://datosclima.es/Aemet2013 Tempestad2013.php	Change (asphalt $\rightarrow$ tree) in runofff $\frac{1}{2}$ coeficient (winter): 0,6 $\rightarrow$ 0,25 (aprox); Change (asphalt $\rightarrow$ tree/green) in runoff (coeficient (summer): 0,55 $\rightarrow$ 0,20 (aprox); Precipitation in Valladolid (2016) = 448 Um2	Urban green up estimation stated in the proposal	UrbanGreenUp project plans to construct 500 m2 of SUDS (Vac 8 & VAc9). According to the increase in drainage surface a bioretention capacity of 150 I/m2 is expected.	
			CHALLENGE 4: Green Space Management	Social indicators (benefits)	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Local Agenda 21 of Valladolid - Sustainability indicators	www.valladolidagendalocal21.es	Percentage of citizens living within 500 meters of a public green area (with an area of more than 5,000 m2) = 96.06% (2014)	Calculated throug Valladolid Population distribution and NBS locations (in terms of distance and time)	n/d	To be calculated once the locations of SUDs are identified
			CHALLENGE 7: Participatory Planning and Governance	Social	Perceptions of citizens on urban nature; - Green spaces quality - Water for drinking quality	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal <u>1.es/</u>	Percentage of population satisfied or very 2 satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65% respectively.	Surverys developed in the URBAN GreenUP Android mobile application (App): Identify Social perception, <sup>1</sup> wellbeing	Satisfaction measure	
			CHALLENGE 1: Climate mitigation	Carbon savings per unit area (environmental, chemical) Carbon storage and sequestration	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(ton CO2/Ha) (ton CO2/year) (ton)	Census of trees and brushes in Valladolid Guide to estimate Carbon Dioxide absorptions (in Spanish) (Spanish Office of Climate Change. Ministry of Agriculture and Environment)	Link to the data source	Value estimated for the proposal preparation: 14,24 tCO2eq p/year	Census of trees and brushes in Valladolid. Data collected during the project. Guide to estimate carbon dioxide absorptions (in Spanish) (Spanish Office of Climate Change. Ministry of Agriculture and Environment)	n/d	[CAR] CARTIF has the expertise to define and calculate this KPI.
			& adaptation	CO <sub>2</sub> eq. Emissions Avoided	CO <sub>2</sub> eq emissions avoided considering a life cycle approach and modelling the environmental impacts regard to indirect savings.	(tCO2eq /year)	IPCC 2013 GWP 2010a methodology. Considering a life cycle approach and modelling the environmental impacts regard to indirect savings.	Comercial Software SimaPro*	Value estimated for the proposal preparation: 20,4 tCO2eq p/year Baseline data not yet calculated. Data collection and calculations in progress.	Collected data about users and uses during the project. IPCC 2013 GWP 2010a methodology. Considering a life cycle approach and modelling the environmental impacts regard to indirect savings.	n/d	[CAR] CARTIF has the expertise to define and calculate this KPI.
				Physical	Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	Bibliography ; Spanish State Meteorological Agency.	http://www.sciencedirect.com.rec rsos.biblioteca.upc.edu/science/ar icle/pii/S1618866713000460; https://datosclima.es/Aemet2013 Tempestad2013.php	<u>u</u> Runoff coeficient (winter): 0,25 (aprox); <u>t</u> runoff coeficient (summer): 0,20 (aprox); <u>/</u> Precipitation in Valladolid (2016) = 448 I/m2	Urban green up estimation stated in the proposal	9000 m2 of Natural WWTP (Vac 13): The increase in drainage surface a bioretention capacity of 150 l/m2 is expected.	
				indicators	Reduction of drought risk (probability).					Data from the proposal.	VAct13 will produce 45,000 m3/year of water to irrigate 6,7ha of green areas in Valladolid. This volume of water shall be address for other municipal uses	
			CHALLENGE 2: Water Management	HALLENGE 2: Vater Aanagement Chem	HALLENGE 2: Vater Aanagement Chemical	Nutrient abatement, abatement of pollutants (%, nutrient load, heavy metals).	Chemical Oxygen Demand (COD) (mg/l); Biochemical Oxygen Demand (BOD) (mg/l); Total Solids (SST) (mg/l)	Manual para la implantación de sistemas de depuración en pequeñas poblaciones (Ministerio de Medio Ambiente y Aguas de Valladolid, 2010)	http://www.centa.es/portfolio- items/manual-la-implantacion- sistemas-depuracion-pequenas- poblaciones/; http://www.aguasdevalladolid.cor /DOC/Caracteristicas Fisico 2011 14(1).odf	Inflow concentrations (2011-2014) = 228 mg/L (D8O) and 240 mg/L (DQO); Removal percentages of CWs = S2 (90-95%); BODS (90-95%); COD(80-90%); TN (60-70%); TP (20-30 %); E coli. 1-2 ulog (Ortega et al., 2010)	Deployment of a sampling plan to quantify Natural WWTP performance in terms of COD, BOD and SST.	Removal percentages of CWs= SS (90- 95%); BODS (90-95%); COD(80-90%); TN (60-70%); TP (20-30%); E coli. 1-2 ulog (Ortega et al., 2010). Final abatment will depend on the inflow water quality.
VAc13	Natural Wastewater Treatment Plant	Natural Wastewater Treatment Plant (NWTP)		quality)	Water for irrigations purposes (m3 ha-1year-1)	(m3/ha/year)	Manual para la implantación de sistemas de depuración en pequeñas poblaciones (Ministerio de Medio Ambiente y Aguas de Valladolid, 2010)	http://www.centa.es/portfolio- items/manual-la-implantacion- sistemas-depuracion-pequenas- poblaciones/; http://www.aguasdevalladolit.com /DOC/Caracteristicas Fisico 2011 14(1).pdf	Inflow concentrations (2011-2014) = 228 mg/L (D8O) and 240 mg/L (DQO); Removal percentages of CWs = SS (90-95%); BODS (90-95%); COD(80-90%); TN (60-70%); TP (20-30 %); E coli. 1-2 ulog (Ortega et al., 2010)	Data from the proposal.	VAct13 will produce 45,000 m3/year of water to irrigate 6,7ha of green areas in Valladolid. This volume of water shall be address for other municipal uses	The volume of reclaimed water potentailly reusable will depend on the performance of the water treatment train.
	, lanc		CHALLENGE 4:	Social indicators	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Local Agenda 21 of Valladolid - Sustainability indicators	www.valladolidagendalocal21.es	Percentage of citizens living within 500 meters of a public green area (with an area of more than 5,000 m2) = 96.06% (2014)	Calculated throug Valladolid Population distribution and NBS locations (in terms of distance and time)	n/d	To be calculated once the locations of SUDs are identified
			Management	(benefits)	Distribution of public green space – total surface or per capita.	(m2/capita) (km <sub>cycle</sub> <sub>lane</sub> /capita)	Local Agenda 21 of Valladolid - Sustainability indicators	www.valladolidagendalocal21.es	Percentage of citizens living within 500 meters of a public green area (with an area of more than 5,000 m2) = 96.06% (2014)	Calculated throug Valladolid Population distribution and NBS locations (in terms of distance and time)	n/d	To be calculated once the locations of SUDs are identified
			CHALLENGE 5: Air Quality	Environmental (chemical)	Trends in emissions NOX, SOX	(µg/m3) SO <sub>2</sub> (µg/m3) NO (µg/m3) NO <sub>2</sub>	Valladolid City Council Air Pollution Control Network (RCCAVA)	www.valladolid.es/es/rccava/dato red/datos-actualizados-temporale	Daily data available. As example: (recorded 5 on 20/10/2017); NO =8 ug/m3; NO2 =22 9 ug/m3; SO2 3ug/m3. Emissions of NO2 in	Valladolid City council will continuously monitor air pollution so the effect of URBAN Green Up will be easily quantified.	NO2 emitted from european wetlands is quantified to be between -2.1 and 1000 mg/m2/day (Sovik et al., 2006).	
			CHALLENGE 6: Urban Regeneration	Urban green indicators (environmental, biological)	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale; ) Green space quantity	(nº species) (% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal <u>1.es/</u>	Percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65% respectively	Valladolid City council will continuously determine th level of satisfaction regarding the quality and quantity , of green spaces in the city so the effect of URBAN Green IP can be quantified	e <sup>7</sup> Satisfaction measure	
			CHALLENGE 7: Participatory Planning and Governance	Social	Perceptions of citizens on urban nature; - Green spaces quality - Water for drinking quality	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal 1.es/	Percentage of population satisfied or very 2 satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65% respectively	Surverys developed in the URBAN GreenUP Android mobile application (App): Identify Social perception, Wellbeing	Satisfaction measure	
			CHALLENGE 8: Social Justice and Social Cohesion	Social cohesion	Green intelligence awareness	(nº educ. actions) (inhab attended)				Awareness campaigns and other social-addressed activitites will be depeloved to show the benefits of natural WWTP		
			CHALLENGE 10: Potential of economic opportunities	Economic	Number of jobs created; gross value added	(jobs) (GDP)						

D2.2 Baseline to Valladolid
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	NBS	NBS Group	NBS	Eklipse	Type of	KPI Definition	KPI unit	Data source	Website	Data values	Data source	Data values	Observations							
Code	Code		Rain gardens	CHALLENGE 1: Climate mitigation & adaptation	Carbon savings per unit area (environmental, chemical) Carbon storage	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(ton CO2/Ha) (ton CO2/year) (ton)	Census of trees and brushes in Valladolid Guide to estimate Carbon Dioxide absorptions (in Spanish) (Spanish Office of Climate Change. Ministry of Agriculture and Environment)	Link to the data source		Census of trees and brushes in Valladolid. Guide to estimate carbon dioxide absorptions (in Spanish) (Spanish Office of Climate Change. Ministry of Agriculture and Environment) Data collected during the project.	n/d								
					Physical	Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)	Bibliography; Spanish State Meteorological Agency	http://www.sciencedirect.com.re rsos.biblioteca.upc.edu/science/a icle/pii/S1618866713000460; https://datosclima.es/Aemet201: Tempestad2013.php	Change (asphalt -> tree) in runoff     coeficient (winter): 0,6 -> 0,25 (aprox); <u> </u> Change (asphalt -> tree) in runoff     coeficient (summer): 0,55> 0,20 (aprox);	Urban green up estimation stated in the proposal	Into VAc10, a 1,000 m2 Rain garden is planned for collecting rainwater in a car park of 5,000 m2 (volume caught in a storm event 750 m3)								
				CHALLENGE 2: Water Management	indicators	Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	Bibliography; Spanish State Meteorological Agency	http://www.sciencedirect.com.rev rsos.biblioteca.upc.edu/science/a icle/pii/S1618866713000460; https://datosclima.es/Aemet201 Tempestad2013.php	PRUNOFF COEfficient (winter): 0,25 (aprox); trunoff coefficient (summer): 0,20 (aprox); Precipitation in Valladolid (2016) = 448 I/m2	Urban green up estimation stated in the proposal	Rain garden of 1,000 m2 is mainly planned for collecting rainwater in a car park of 5,000 m2 (volume caught in a storm event 750								
	Ac10	Rain gardens				Chemical indicators (water quality)	Water for irrigations purposes (m3 ha-1year-1)	(m3/ha/year)				Data from the proposal.	67.5 m3/year, the estimated volume for the irrigation of this new green area, will be used in other purposes							
				CHALLENGE 4: Green Space Management CHALLENGE 6: Urban Regeneration	CHALLENGE Green Space Managemer	CHALLENGE 4: Green Space Management	CHALLE Green S Manage	CHALLENGE 4: Green Space Management	Social indicators (benefits)	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Local Agenda 21 of Valladolid - Sustainability indicators	www.valladolidagendalocal21.e	Percentage of citizens living within 500 meters of a public green area (with an area of more than 5,000 m2) = 96.06% (2014)	Calculated throug Valladolid Population distribution and NBS locations (in terms of distance and time)	n/d	To be calculated once the locations of SUDs are identified			
					CHALLENGE 6: Urban Regeneration	Urban green indicators (environmental, biological)	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale; ) Green spaces quantity	(nº species) (% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendaloca 1.es/	Percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65% respectively	Valladolid City council will continuously determine the level of satisfaction regarding the quality and quantity , of green spaces in the city so the effect of URBAN GreenUP can be quantified	e <sup>7</sup> Satisfaction measure							
				CHALLENGE 7: Participatory Planning and Governance	Social	Perceptions of citizens on urban nature; - Green spaces quality - Water for drinking quality	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendaloca <u>1.es/</u>	Percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65% respectively	Surverys developed in the URBAN GreenUP Android mobile application (App): Identify Social perception, wellbeing	Satisfaction measure								
				CHALLENGE 1: Climate mitigation & adaptation	Carbon savings per unit area (environmental, chemical) Carbon storage and sequestration in vegetation and	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year). Total amount of carbon stored in vegetation (ton)	(ton CO2/Ha) (ton CO2/year) (ton)	Census of trees and brushes in Valladolid. GGuide to estimate carbon dioxide absorptions (in Spanish) (Spanish Office of Climate Change. Ministry of Agriculture and Environment).	Link to the data source	Value estimated for the proposal preparation: 14,24 tCO2eq p/year	Census of trees and brushes in Valladolid. Data collected during the project. Guide to estimate carbon dioxide absorptions (in Spanish) (Spanish Office of Climate Change. Ministry of Agriculture and Environment)		[CAR] CARTIF has the expertise to define and calculate this KPI.							
		Green filter				Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	Bibliography ; Spanish State Meteorological Agency.	http://www.sciencedirect.com.re ros.biblioteca.upc.edu/science/a icle/pii/S1618866713000460; https://datosclima.es/Aemet2011 Tempestad2013.php	면 Runoff coeficient (winter): 0,25 (aprox); tr runoff coeficient (summer): 0,20 (aprox); 사 Precipitation in Valladolid (2016) = 448 l/m2	Urban green up estimation stated in the proposal	10,000 m2 of green filter								
					Physical indicators	Areas (Ha) and population (inhab) exposed to flooding	(Ha) (inhab)	National Flood Zone Mapping System	http://sig.mapama.es/snczi/visor tml	340 Ha and 54.424 inhabitants (10 years return period flood); 620 Ha and 99.312 inhabitants (100 years return period flood) 1.497 Ha and 239.672 inhabitants (500 years return period flood)	Flood models should be developed to study the effect of the floodable park with respect the current situation	n/d	VAc12 is connected to VAc11 (floodable park) so the KPI shall be calculated jointly							
v	Ac12		Green filter area	CHALLENGE 2:		Flood peak reduction (lacob et al., 2014), Increase in time to peak (lacob et al., 2014) (%).	(%)	Caumax (Map of maximum flows in natural regime)	http://sig.mapama.es/snczi/visor tml	Flow: 20 m3/s (10 years return period <u>h</u> flood); Flow: 56 m3/s (100 years return period flood); Flow: 109 m3/s (500 years return period flood)	Flood models should be developed to study the effect of the floodable park with respect the current situation	n/d								
VAC.		area		Water Management	Water Management	Water Management	Water Management	t	ater anagement	Population exposed to flood risk (% per unit area)	(%/m2)	National Flood Zone Mapping System	http://sig.mapama.es/snczi/visor tml	17,47% total inhabitants (10 years return <u>h</u> period flood); 31,88% total inhabitants (10) years return period flood); 76,94% total inhabitants (500 years return period flood)	Flood models should be developed to study the effect of the floodable park with respect the current situation	VAc12 will be connected to VAc11 (floodable park). This work shall be done jointly				
				_						in	Che	Chemical indicators (water	Nutrient abatement, abatement of pollutants (%, nutrient load, heavy metals).	Chemical Oxygen Demand (COD) (mg/l); Biochemical Oxygen Demand (BOD) (mg/l); Total Solids (SST) (mg/l)	Manual para la implantación de sistemas de depuración en pequeñas poblaciones ( Ministerio de Medio Ambiente y Aguas de Valladolid, 2010)	http://www.centa.es/portfolio- items/manual-la-implantacion- sistemas-depuracion-pequenas- poblaciones/. http://www.aguasdevalladoild.co. /DOC/Caracteristicas_Fisiko_2011 14(1).pdf	Removal percentages of Green filter= SS (9) 95%); BOD5 (90-95%); CDD(80-90%); TN 	Deployment of a sampling plan to quantify Natural WWTP performance in terms of COD, BOD and SST.	Removal percentages of green filter= SS (90-95%); BODS (90-95%); CDD(80-90%); TN (60-70%); TP (20-30%)(Ortega et al., 2010). Final abatment will depend on the inflow water quality.	[CEN] Sampling campaigns needed for monitoring the performance of the natural WWTP and the amount of pollutants removed.
							quality)	Water for irrigations purposes (m3 ha-1year-1)	(m3/ha/year)	Manual para la implantación de sistemas de depuración en pequeñas poblaciones ( Ministerio de Medio Ambiente y Aguas de Valladolid, 2010)	http://www.centa.es/portfolio- items/manual-la-implantacion- sistemas-depuration-pequenas- poblaciones/. http://www.aguasdevalladolid.co /DOC/Caracteristicas_Fisico_2011	Removal percentages of green filters= SS . (90-95%); 80DS (90-95%); COD(80-90%); TN (60-70%); TP (20-30%); (Ortega et al., 	Data from the proposal.	In VAc12, 4,500 m3/year of water will be treated and used for irrigation. This volume of water shall be address for other municipal uses						
				CHALLENGE 4: Green Space Management	Social indicators (benefits)	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Local Agenda 21 of Valladolid - Sustainability indicators	www.valladolidagendalocal21.e	Percentage of citizens living within 500 meters of a public green area (with an area of more than 5,000 m2) = 96.06% (2014)	Calculated throug Valladolid Population distribution and NBS locations (in terms of distance and time)	n/d	To be calculated once the locations of SUDs are identified							

#### Annex IV. Nature Based Solutions > KPIs > Data

NBS	NBS Group	NBS	Eklipse	Type of	KPT Definition	KRT unit	Data source	Wabsite	Data values	Data source	Data values	Observations
Code		Description	challenge	indicator Carbon savings		KF1 unit		Website				Observations
			CHALLENGE 1: Climate mitigation	per unit area (environmental, chemical)	Tonnes of carbon removed or stored per unit area per unit time (ton CO2/Ha) (ton CO2/year).	(ton CO2/Ha) (ton CO2/year)	Census of trees and brushes in Valladolid. Guide to estimate Carbon Dioxide absorptions	Link to the data source	Value estimated for the proposal preparation:	Census of trees and brushes in Valladolid. Guide to estimate Carbon Dioxide absorptions	Vac7 will sequestrate carbon dioxide equivalent to 16,5 t/year.Vac 2,3,4,5 will	[CAR] CARTIF has the expertise to define and calculate this KPI. KPI selected by
			& adaptation	Carbon storage and sequestration	Total amount of carbon stored in vegetation (ton)	(ton)	Agriculture and Environment)		45,68 tCO2eq p/year	Agriculture and Environment)	eq./year due trees activity.	CARTIF.
	Floodable park			SE 2: Physical Indicators	Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	Bibliography; Spanish State Meteorological Agency			References that are being discussing at NBS European projects level in Task force groups promoted by EASME and EU Commission		[CAR] The methodology for calculating it is not established
		Floodable park	CHALLENGE 2: Water		ALLENGE 2: Physical	Areas (Ha) and population (inhab) exposed to flooding	(Ha) (inhab)	National Flood Zone Mapping System	http://sig.mapama.es/snczi/visor.h tml	340 Ha and 54.424 inhabitants (10 years return period flood); 620 Ha and 99.312 inhabitants (100 years return period flood); 1.497 Ha and 239.672 inhabitants (500 years return period flood)	Flood models should be developed to study the effect of the floodable park with respect the current situation	n/d
VAc11			Management		Decrease of peak flow values for different return periods of Esgueva river just upstream the city of Valladolid.	(m3/s)	Caumax (Map of maximum flows in natural regime)	http://sig.mapama.es/snczi/visor.h tml	Flow: 20 m3/s (10 years return period flood); Flow: 56 m3/s (100 years return period flood); Flow: 109 m3/s (500 years return period flood)	Flood models should be developed to study the effect of the floodable park with respect the current situation	n/d	[CHD] Confederación Hidrográfica del Duero will conduct these flow models.
					Population exposed to flood risk (% total inhabitants in the municipality of Valladolid).	(%)	National Flood Zone Mapping System	http://sig.mapama.es/snczi/visor.h tml	17,47% total inhabitants (10 years return period flood); 31,88% total inhabitants (100 years return period flood); 76,94% total inhabitants (500 years return period flood)	Flood models should be developed to study the effect of the floodable park with respect the current situation	n/d	[CHD] Confederación Hidrográfica del Duero will conduct these flow models.
			CHALLENGE 4: Green Space	Social indicators	Accessibility to green zones (measured as % inhabitants of city of Valladolid living closer than 500 m. of any green area bigger than 500 m. of any green area bigger than	(%)	Sustainability Indicators - Ag21 Valladolid	http://valladol- cp76.webjoomla.es/concejalia/age ndalocal21/indicadores/indicadore	96,06% (data of 2014)	Sustainability Indicators - AG21 Valladolid	n/d	
			Management	(benefits)	Distribution of public green space – total surface or per capita.	(Ha) (m2/inhab)	Environment and Sustainable Development. Valladolid City Council		515,79 Ha; 17,09m2/inhab.	Environment and Sustainable Development. Valladolid City Council	520,79 Ha; 17,25m2/inhab	
			CHALLENGE 5: Air Quality	Environmental (chemical)	Trends in emissions CO	(mg/m <sup>3</sup> )	Valladolid City Council Air Pollution Control Network (RCCAVA)	http://www.valladolid.es/es/rccava /datos-red	CO Maximum value per hour, year 2016: 2 mg/m3	RCCAVA will continuously measure air quality so the effect of UrbanGreenUp will be quantified.		[CAR] KPI selected by CARTIF.
			CHALLENGE 9: Public Health and Well-being	Health indicators	Increase in walking and cycling in and around areas of interventions.	(users) (bicycles)	Mobility. Valladolid City Council		base number of walkers and bikers in current situation = 0	Mobility. Valladolid City Council	n/d	
			CHALLENGE 1: Climate mitigation & adaptation Oth	Temperature reduction	Decrease in mean or peak daytime local temperatures (*C)	(°C)	Spanish State Meteorological Agency. Data from RCCAVA.	https://datosclima.es/Aemet2013/ Tempestad2013.php www.valladolid.es/es/rccava	Temperature record from May 2013	Data from RCCAVA. Wireless Network of T and RH sensors	www.valladolid.es/es/rccava Valladolid Project Platform	
				Others	Use of Star tools to calculate projected maximum surface temperature reduction (°C)	(°C)				Star tools (projected temperature reduction)		
					Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)	Annual rainfall data	http://www.aemet.es/es/serviciose limaticos/vigilancia dima/resumer	1			
			CHALLENGE 2: Water	Physical indicators	Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	annual rainfall data; Absorption water by capillarity, floor tiles, normative	http://www.aemet.es/es/servicioso limaticos/vigilancia clima/resumer	<u>1</u>			
			Management		Temperature reduction in urban areas (°C, % of energy reduction for cooling)	(°C, % of energy reduction for cooling)	Annual temperatures (RCCAVA, aemet)	https://es.climate- data.org/location/581/				
VAc14	Green Parking	Green parking			Volume of water slowed down entering sewer system	(€/m3)						
	Pavements	pavements	CHALLENGE 6: Urban Regeneration	Urban green indicators (environmental,	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale; ) Green spaces quantity	(nº species) (% satisfaction)						
			CHALLENGE 7: Participatory Planning and	Social	Perceptions of citizens on urban nature - Green spaces quality	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 1.es/	Percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65%	Surverys developed in the URBAN GreenUP Android mobile application (App): Identify Social perception, wellbeing	Satisfaction measure	
			CHALLENGE 9: Public Health and Well-being	Psychological indicators (Relaxation and	Noise reduction rates - Defined road buffer dB(A) m-2 vegetation unit	(dB(A) /m2 vegetation unit)	Acoustic absorption coefficients materials.	http://www.fadu.edu.uy/acondicio namiento-acustico/wp- content/blogs.dir/27/files/2012/02 //fablas.de.0hroscipr.coff	<u>.</u>			
			CHALLENGE 10: Potential of economic	Economic	New businesses attracted and additional business rates (Eftec, 2013).	(business)						

#### Annex IV. Nature Based Solutions > KPIs > Data

NDC		NDC	Flationer	<b>T</b>								
Code	NBS Group	Description	challenge	indicator	KPI Definition	KPI unit	Data source	Website	Data values	Data source	Data values	Observations
VAc16	5 Smarts soils as	Smarts soils	CHALLENGE 2: Water	Physical indicators	Absorption capacity of green surfaces, bioretention structures and single trees (m3/m2) (m3/tree)	(m3/m2) (m3/tree)	Bibliography; Spanish State Meteorological Agency					
VAC18	substrate	pedestrian	CHALLENGE 5: Air Quality	Environmental (chemical)	Trends in emissions NOX, SOX	(μg/m3) SO <sub>2</sub> (μg/m3) NO (μg/m3) NO <sub>2</sub>	Valladolid City Council Air Pollution Control Network (RCCAVA)	http://www.valladolid.es/es/rccava		Data from RCCAVA. Wireless Network of T and RH sensors	www.valladolid.es/es/rccava Valladolid Project Platform	[CAR] CARTIF will install and follow the network.
VAc19 VAc20 VAc21	9	Natural			Increased connectivity to existing GI	(m) (%)	No previous data.	n/d	n/d	Methodology and data collection in comming months.	n/d	
VAc20	Pollinators	pollinator's	CHALLENGE 4: Green Space	Environmental	Pollinator species increase (number)	(nº) (%)	No previous data.	n/d	n/d	Methodology and data collection in comming months.	n/d	
VAc21	1 modules	modules (A,	Management	(Diological)	Perceptions of connectivity and mobility.	Survey	No previous data.	n/d	n/d	Methodology and data collection in comming months.	n/d	
		<u>C)</u> .		Temperature			Spanish State Meteorological Agency.	https://datosdima.es/Aemet2013/		Data from RCCAVA.	www.valladolid.es/es/rccava	[CAR] CARTIF will install and follow the
			CHALLENGE 1: Climate mitigation	reduction	Decrease in mean or peak daytime local temperatures (°C)	(°C)	Data from RCCAVA.	Tempestad2013.php www.valladolid.es/es/rccava	Temperature record from May 2013	Wireless Network of T and RH sensors	Valladolid Project Platform	network.
			& adaptation	(environmental, physical)	Heatwave risks (number of combined tropical nights (>20 $^{\circ}C$ ) and hot days (>35 $^{\circ}C$ )	(nº days)	Spanish State Meteorological Agency. Data from RCCAVA.	https://datosclima.es/Aemet2013/ Tempestad2013.php www.valladolid.es/es/rccava	Temperature record from May 2013	Data from RCCAVA. Wireless Network of T and RH sensors	www.valladolid.es/es/rccava Valladolid Project Platform	[CAR] CARTIF will install and follow the network.
				Environmental (biological)	Pollinator species increase (number)	(nº) (%)	No previous data.	<u>n/d</u>	n/d	Methodology and data collection in comming months.	n/d	
			CHALLENGE 4: Green Space Management	E 4: Se Social indicators (benefits)	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 1.es/	To be determined.	Stadistical data. Project information.	n/d	[CAR] Comment: Could this kind of interventions consider as green spaces?
		Green noise barriers; Green vertical mobile garden; Green façade			Distribution of public green space – total surface or per capita.	(m2/capita) (km cycle lane/capita)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2	To be determined.	Stadistical data. Project information.	n/d	[CAR] Comment: Valladolid could be a pioneer in this sense.
					Annual mean levels of fine particulate matter (e.g. PM2.5 and	(µg/m3) PM2.5	Valladolid City Council Air Pollution Control Network	http://www.valladolid.es/es/rccava	PM10: 17 ug/m3 (2016): PM2 5: 15 ug/m3			·
			CHALLENGE 5: Air Quality	5: Environmental (chemical)	PM10) in cities (population weighted) concentration recorded	(µg/m3) PM10	(RCCAVA) Valladolid City Council Air Pollution Control Network	/datos-red http://www.valladolid.es/es/rccava	Maximum value 50, vear 2016: 24 ug/m2			
VAc2	2					(µg/113/302	(RCCAVA) Valladolid City Council Air Pollution Control Network	/datos-red http://www.valladolid.es/es/rccava	NO <sub>2</sub> Maximum value per hour, year 2016:			
VACZZ	3 Vertical green				Trends in emissions NUX	(µg/m3) NO (µg/m3) NO2	(RCCAVA)	/datos-red http://www.valladolid.es/es/rccava	191 ug/m3 CO Maximum value per hour year 2016: 2			
VAc24	4 interventions				Trends in emissions CO	(mg/m³)	(RCCAVA)	/datos-red	mp/m3			
VAc25	5				Annual mean levels of Benzene C <sub>6</sub> H <sub>6</sub>	μg/m3	(RCCAVA)	/datos-red	year 2016: 0.3µg/m3			
					Concentration of formaldehyde in air.	ppm				Instalation of sensors for monitoring	Trends in emissions of formaldehyde	
					Annual mean levels of Xylene C6H4 (CH3) <sub>2</sub>	μg/m3				Instalation of sensors for monitoring	Annual mean levels of Xylene C6H4 (CH3)2	
			CHALLENGE 6:	Socio-cultural	Savings in energy use due to improved GI	(kWh/m <sup>2</sup> )				Electricity meter to measure the expenses in air conditioning and heating.	KWh/m <sup>2</sup>	
			Regeneration	indicators	Assessment of typology, functionality and benefits provided pre	(m²/capita)				m <sup>2</sup> developed in the project + existing green m <sup>2</sup> .	m <sup>2/</sup> capita	
			CHALLENGE 9: Public Health and Well-being	Psychological indicators (Relaxation and restoration, sense of place, exploratory	Noise reduction rates	(dB(A)) (exposed population to noise)	Valladolid City Council Air Pollution Control Network (RCCAVA). Strategic Noise Map (Ministry of Environment, MAPAMA). Municipal Plan against Noise Pollution of Valladolid.	www.valladolid.es/es/rccava/datos resd. http://sicaweb.cedex.es/docs/map as/fase1/aglomeracion/Valladolid/ resumen.pdf http://valladol: cp76.webjoomla.es/concejalia/plan	2016 results: Ld: 59,9 dB; Le: 59,8 dB; Ln: 51,3 dB; Lden: 61,0 dB Population (hundreds) exposed to noise Lden: (55-59 dBa) = 372; (60-64 dBa) = 441; (65-69 dBa) = 208; (70-74 dBa) = 87; (>75 dBa) = 1.	n/d	n/d	(VAL) Noise measurements plan for the NBS
			CHALLENGE 10: Potential of	Economic	New businesses attracted and additional business rates (Eftec, 2013)	(business)				Opening License Department Details	nº new bussines/year	
			economic	Economic	Number of jobs created; gross value added	(jobs) (GDP)				Parks and gardens Department (Valladolid City Council - Environment)	number of new jobs	
			CHALLENGE 1: Climate mitigation & adaptation	Temperature reduction	Decrease in mean or peak daytime local temperatures (*C)	(°C)	Spanish State Meteorological Agency. Data from RCCAVA.	https://datosclima.es/Aemet2013/ Tempestad2013.php www.valladolid.es/es/rccava	Temperature record from May 2013	Data from RCCAVA. Wireless Network of T and RH sensors	www.valladolid.es/es/rccava Valladolid Project Platform	[CAR] CARTIF will install and follow the network.
				tion (environmental, physical)	Heatwave risks (number of combined tropical nights (>20 °C) and hot days (>35 °C)	(nº days)	Spanish State Meteorological Agency. Data from RCCAVA.	https://datosclima.es/Aemet2013/ Tempestad2013.php www.valladolid.es/es/rccava	Temperature record from May 2013	Data from RCCAVA. Wireless Network of T and RH sensors	www.valladolid.es/es/rccava Valladolid Project Platform	[CAR] CARTIF will install and follow the network.
			CHALLENGE 2:	Physical	Run-off coefficient in relation to precipitation quantities (mm/%)	(mm/%)	Bibliography; Spanish State Meteorological Agency			Flowmeter in drain pipe.	(mm/%)	
			Water Management	Chemical	Water for irrigations purposes (m3 ha-1year-1)	(m3/ha/year)				Water meter	(m3/ha/year)	
			CHALLENGE 4: Green Space	Environmental (biological)	Pollinator species increase (number)	(nº) (%)	No previous data.	<u>n/d</u>	n/d	Methodology and data collection in comming months.	n/d	
				LLENGE 4: (Undigical) n Space agement Social indicators (benefits)	Accessibility (measured as distance or time) of urban green	(m) (min)	Local Agenda 21 of Valladolid - Sustainability	http://www.valladolidagendalocal2	To be determined	Stadistical data.	n/d	[CAR] Comment: Could this kind of
		Green	Management		spaces for population. Distribution of public green space – total surface or per capita.	(m2/capita) (km cycle	indicators Local Agenda 21 of Valladolid - Sustainability	1.es/ http://www.valladolidagendalocal2	To be determined.	Project information. Stadistical data.	n/d	interventions consider as green spaces? [CAR] Comment: Valladolid could be a
VAc27	7 Horizontal	covering			Annual mean levels of fine particulate matter (e.g. PM2.5 and	lane/capita) (ug/m3) PM2.5	indicators Valladolid City Council Air Pollution Control Network	1.es/ http://www.valladolid.es/es/rccava		Project information.		pioneer in this sense.
VAc28	8 green	roof: Green			PM10) in cities (population weighted) concentration recorded	(µg/m3) PM10	(RCCAVA)	/datos-red	PM10: 17 μg/m3 (2016); PM2,5: 15 μg/m3			
VAc29	9 interventions	shady			Trends in emissions SOX	(μg/m3) SO <sub>2</sub>	Validabild City Council Air Poliution Control Network	/datos-red	Maximum value SO <sub>2</sub> , year 2016: 34 µg/m3			
		structures	CHALLENGE 5:	Environmental	Trends in emissions NOX	(µg/m3) NO (µg/m3) NO2	Valiadoid City Council Air Pollution Control Network	/datos-red	NO <sub>2</sub> Maximum value per nour, year 2016:			
			Air Quality	(chemical)	Trends in emissions CO	(mg/m <sup>3</sup> )	Valiauolid City Council Air Pollution Control Network	//www.vanadonio.es/es/rccava //datos-red	co waximum value per hour, year 2016: 2			
					Annual mean levels of Benzene C <sub>6</sub> H <sub>6</sub>	μg/m3	Valiauolid Lity Council Air Pollution Control Network	/datos-red	year 2016: 0.3µg/m3			
					Concentration of formaldehyde in air.	ppm				Instalation of sensors for monitoring	Trends in emissions of formaldehyde	
					Annual mean levels of Xylene C6H4 (CH3) <sub>2</sub>	μg/m3				Instalation of sensors for monitoring	Annual mean levels of Xylene C6H4	
			CHALLENGE 6: Urban	Socio-cultural	Savings in energy use due to improved GI	(kWh/m <sup>2</sup> )				Electricity meter to measure the expenses in air conditioning and heating.	KWh/m <sup>2</sup>	
			Regeneration	indicators	Assessment of typology, functionality and benefits provided pre and post interventions	(m²/capita)				$m^2$ developed in the project + existing green $m^2$ .	m <sup>2/</sup> capita	
			CHALLENGE 10: Potential of	Economic	New businesses attracted and additional business rates (Eftec,	(business)				Opening License Department Details	nº new bussines/year	
1	1	1	economic	Economic	Number of jobs created: gross value added	(iobs) (GDP)				Parks and gardens Department (Valladolid City	number of new jobs	1

NBS	NBS Group	NBS	Eklipse	Type of	KPI Definition	KPI unit	Data source	Website	Data values	Data source	Data values	Observations
VAc26		Electro wetland	CHALLENGE 1: Climate mitigation & adaptation	Temperature reduction (environmental, physical)	Decrease in mean or peak daytime local temperatures ("C)	("C)	Agencia Estatal de Meteorologia (AEMET)	http://www.aemet.es	Tmax (monthly average 2015-2017)= 20 ± 8 %C; Tav (monthly average 2015-2017)= 14 ± 7 %C	Installation of sensors for temperature monitoring at the NBS ubication	Values of heat island effect reduction are expected to be within the range of bibliography reported for similar GI (reductions between 1,3 adn 2,8 °C are reported; Demuzere et al., 2014)	[LEI] No specific data from the NBS location available
			CHALLENGE 2: Water	Physical indicators	Temperature reduction in urban areas (°C, % of energy reduction for cooling)	(°C, % of energy reduction for cooling)	Agencia Estatal de Meteorologia (AEMET)	http://www.aemet.es	Tmax (monthly average 2015-2017)= 20 ± 8 °C; Tav (monthly average 2015-2017)= 14 ± 7 ℃	Installation of sensors for temperature monitoring at the NBS ubication	Values of heat island effect reduction are expected to be within the range of bibliography reported for similar GI (reductions between 1,3 adn 2,8 °C are reported and associated to 10% of energy savings in the surrounding buildings; Demuzer et al., 2014)	[LEI] No specific data from the NBS location available
			Management	Chemical indicators (water quality)	Nutrient abatement, abatement of pollutants (%, nutrient load, heavy metals).	Chemical Oxygen Demand (COD) (mg/l); Biochemical Oxygen Demand (BOD) (mg/l); Total Solids (SST) (mg/l)	Manual para la implantación de sistemas de depuración en pequeños poblaciones (Ministerio de Medio Ambiente y Aguas de Valladolid, 2010)	http://www.centa.es/portfolio- items/manualla-implantacion- sistemas-depuracion-pequenas- poblaciones/, http://www.aguasdevalladolid.com //DOC/caracteristicas_fisio_2011- 14(11).off	Inflow concentrations (2011-2014) = 228 mg/L (DBO) and 240 mg/L (DQO); Removal percentages of HSST CWs= SS (90-95%); BODS (90-95%); COD(80-90%) (Ortega et al., 2010);	Deployment of a sampling plan to quantify EW treatment rates in terms of COD, BOD and SST. Inflow and outflow of the DEMO-system will be analysed.	Removal percentages of HSST CWs= SS (85-95%); BODS (85-95%); COD(80-90%) (Ortega et al., 2010). Nutrient abatement as function of the influent wastewater pollution.	[LEI] No specific data from the NBS location available
	Electro wetland		CHALLENGE 4: Green Space Management	Social indicators (benefits)	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (%)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 <u>1.es/</u>	96% of the population lived at a lower distance of 500 m form a green space of, at least, 5000 m2) (2014)	Valladolid City council will continuously determine the accessibility to green spaces so the effect of URBAN Green Up can be quantified.	n/d	[LEI] Electrowetland location is under decision. If it is finally placed over in an already green area it will not improve accessibility to Green Spaces. Furthermore, due to the presence of urban wastewater, citizens will not have acces to the NBS.
			CHALLENGE 5: Air Quality	Environmental (chemical)	Trends in emissions NOX, SOX	(μg/m3) SO <sub>2</sub> (μg/m3) NO (μg/m3) NO <sub>2</sub>	Valladolid City Council Air Pollution Control Network (RCCAVA)	www.valladolid.es/es/rccava/datos- red/datos-actualizados-temporales	Daily data available. As example: (recorded on 20/10/2017); NO =8 ug/m3; NO2 =22 ug/m3; SO2 3ug/m3. Emissions of NO2 in	Valladolid City council will continuously monitor air pollution so the effect of URBAN Green Up will be easily quantified.	NO2 emitted from european wetlands is quantified to be between -2.1 and 1000 mg/m2/day (Sovik et al., 2006).	[LEI] NO <sub>2</sub> emissions from constructed wetlands are of low magnitude and very variable and therefore difficult to quantify
			CHALLENGE 6:	Urban green indicators (environmental, biological)	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale; ) Green spaces quantity	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 <u>1.es/</u>	Percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65%, respectively	Valladolid City council will continuously determine the level of satisfaction regarding the quality and quantity of green spaces in the city so the effect of URBAN GreenUP can be quantified	Satisfaction measure	
			Regeneration	Socio-cultural indicators	Savings in energy use due to improved GI	(kWh)	Villaseñor, J., Capilla, P., Rodrigo, M. a, Cañizares, P., Fernández, F.J., 2013. Operation of a horizontal subsurface flow constructed wetland-microbial fuel cell treating wastewater under different organic londing rates. Water Rev. 47, 6731–9	http://www.sciencedirect.com/scie nce/article/pii/S004313541300684 2	0,025 KWh	A datalogger will be installed in order to record the electricity produced by the system.	Results are exepected to be in the range of the bibliography (0,025 KWh, Villaseñor et al. 2013).	[LEI] There is no data available of the generation of electricity by systems of the scale of the DEMO implemented in Valladolid in the context of the projecte UBBAN Group IP
			CHALLENGE 7: Participatory Planning and Governance	Social	Perceptions of citizens on urban nature: - Green spaces quality - Water for drinking quality - Air quality	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 1.es/	Percentage of population satisfied or very satisfied with the quantity and quality of green spaces in the city (2014): 68 and 65%, respectively	Valladolid City council will continuously determine the level of satisfaction regarding the quality and quantity of green spaces in the city.	Satisfaction measure	
			CHALLENGE 8: Social Justice and Social Cohesion	Social cohesion	Green intelligence awareness	(nº educ. actions) (inhab attended)	No data found to define the baseline			Expected educational activities in URBAN GreenUP.	Educational actions to explain the technology and its benefits to Valladolid's citizens will be developed.	
			CHALLENGE 10: Potential of economic opportunities and green jobs	Economic	Consumption benefits: property betterment and visual amenity enhancement (Tyler et al., 2013) resulting from NBS.	(€)	Valladolid City Council - Online public data	http://www.valladolidencifras.es	Empty bousing price (mean value 2015- 2017): 1,239 euros; mean value 2017: 1,207 euros.	Valladolid City council will continuously determine empty housing price	Electrowetland location is under decision. If it is finally placed over an already green area it will not influence on housing prices. Contrarily it generates a new green urbans pace it may have an influence of surrounding houses pricing. Estimations of a positive impact of 20% on property values fronting a passive park are described in bibliography (Crompton, 2005)	[LE] No specific data from the NBS location available
					Annual mean levels of fine particulate matter (e.g. PM2.5 and PM10) in cities (population weighted) concentration recorded us/m3	(µg/m3) PM2.5 (µg/m3) PM10	RCCVA (http://www.valladolid.es/es/rccava/rccava)	http://www.valladolid.es/es/rccava /contaminantes	(µg/m3) PM2.5 (µg/m3) PM10			
				Environmental (chemical)	Trends in emissions NOX, SOX	(μg/m3) SO <sub>2</sub> (μg/m3) NO (μg/m3) NO <sub>2</sub>	RCCVA (http://www.valladolid.es/es/rccava/rccava)	http://www.valladolid.es/es/rccava /contaminantes	(µg/m3) SO2 (µg/m3) NO (µg/m3) NO2			
	University of the second s	Ushan sandan			Mean levels of exposure to ambient air pollution (population weighted) (proposed indicator for SDG target 3.9)	(inhab) (kg CO2/km car)	RCCVA (http://www.valladolid.es/es/rccava/rccava)	http://www.valladolid.es/es/rccava /contaminantes	(inhab) (kg CO2/km car)	Monitoring of biofilter	75 % reduction	
VAc30	Urban garden bio-filter	bio-filter	CHALLENGE 5: Air Quality	Economic	Monetary values: value of air pollution reduction; total monetary value of urban forests including air quality, run-off mitigation, energy savings, and increase in property values. use of GI val to calculate the value of air quality improvements	(€)	Sanidad Castilla y León. Consejería de Sanidad de Castilla y León	https://www.saludcastillayleon.es/ es				
				Environmortel	Number of deaths from air, water and soil pollution and contamination (proposed indicator for SDG target 3.9)	(nº deaths)	Sanidad Castilla y León. Consejería de Sanidad de Castilla y León	https://www.saludcastillayleon.es/ es				
				(chemical)	Air quality parameters NOx, VOC, PM etc	(μg/m3) CO (mg/m3) O <sub>3</sub> (μg/m3) C <sub>6</sub> H <sub>6</sub>	RCCVA (http://www.valladolid.es/es/rccava/rccava)	http://www.valladolid.es/es/rccava /contaminantes		Monitoring of biofilter	75 % reduction	

NBS Code	NBS Group	NBS Description	Eklipse challenge	Type of indicator	KPI Definition	KPI unit	Data source	Website	Data values	Data source	Data values	Observations
	Urban farming promotion			Environmental (biological)	Production of food (ton/Ha/year)	(ton/Ha/year)	Ecological orchards of Valladolid (2016-2017)	http://www.valladolid.es/es/actual idad/noticias/huertos-ecologicos- 2016-2017				
		Urban orchard;	CHALLENGE 4: Green Space Management	CHALLENGE 4: Green Space Management	Social indicators	Accessibility (measured as distance or time) of urban green spaces for population.	(m) (min)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 1.es/		Stadistical data Project information	
VAc31 VAc32		Community composting;		(penetits)	Being valued for recreation, social interaction, education and supporting healthy living	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 1.es/				[CAR] It is difficult to know individuals involved in this activities
VAc33		Small-scale urban	CHALLENGE 6: Urban Regeneration	Urban green indicators (environmental, biological)	Enhance biodiversity and community engagement. Convert brownfield to green areas in urban regeneration projects.	(m2)	Ecological orchards of Valladolid (2016-2017)					
		livestock	CHALLENGE 10: Potential of economic opp. and green jobs	Economic	Number of jobs created: Number of people who find a job and leave the urban orchard. Gross value added: Compost production (kg/year) (€/year)	(jobs) (kg <sub>compost</sub> /year) (€ <sub>saved</sub> /year)	Ecological orchards of Valladolid (2016-2017)			Number of people who find a job and leave the urban orchard. Compost production	(nº employees) (kg/year) (€/year)	
VAc24	Educational activities	Educational	CHALLENGE 4:	Social indicators	Accessibility (measured as distance or time) of urban green spaces for population	(m) (min)						
VAC34 VAc35		paths (A, C);	Management	(benefits)	Weighted recreation opportunities provided by Urban Green Infrastructure.	(nº)						
VAc36		farming	CHALLENGE 8: Social Justice and Social Cohesion	Social cohesion	Green intelligence awareness	(nº educ. actions) (inhab attended)	No data found to define the baseline			Expected educational activities in URBAN GreenUP.	Educational actions to explain the technology and its benefits to Valladolid's citizens will be developed.	
VAc37 VAc39 VAc40 Vac42	Promotion of NBS at citizen scale	Engagement Portal for	CHALLENGE 6: Urban Regeneration	Urban green indicators (environmental, biological)	Accessibility: distribution, configuration, and diversity of green space and land use changes (multi-scale; ): - Green spaces quantity	(% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	http://www.valladolidagendalocal2 Gr 1.es/ sat	een spaces quantity indicator = 68% tisfaction (2014)	Surverys developed in the URBAN GreenUP Android mobile application (App)	Satisfaction measure	
		Promotion of ecological reasoning and	CHALLENGE 7: Participatory Planning and Governance	Social	Perceptions of citizens on urban nature: - Green spaces quality - Water for drinking quality - Air quality	(% satisfaction) (% satisfaction) (% satisfaction)	Local Agenda 21 of Valladolid - Sustainability indicators	Gr sat <u>http://www.valladoiidagendalocal2</u> Dr <u>1.es/</u> sat Air (2)	een spaces quality indicator = 68% tisfaction (2014) inking water quality indicator = 53% tisfaction (2014) r quality indicator = 52% satisfaction 01d)	Surverys developed in the URBAN GreenUP Android mobile application (App)	Satisfaction measure	
VAc38	Support and	Sponsoring	CHALLENGE 10: Potential of	Economic	Number of jobs created; gross value added	(jobs) (GDP)						