

REPORT ON PRINCIPLES FOR SELECTION OF INTERVENTIONS

DELIVERABLE D.T1.2.1

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1. INTRODUCTION

The UEA (Urban Environmental Acupuncture) is based on precise, optimal choice of sites, and on the optimal choice of intervention, what means activities aimed at transforming these sites into green-spots. The expected effect is to improve the quality of urban space at various scales, from place to FUA, both in environmental and social terms. This report is the second and final part of the description of transnational methodology of site selection and of intervention type selection, for UEA at FUA scale. The previous report (D.T1.1.1) concerned the diagnosis of deficit areas and selection of UEA sites, while this document defines how to select best intervention type for a given type of site.

Urban space, as well as places in this space, among them enclaves of greenery, despite their great diversity, have many repetitive features. Recognizing this, significant efforts have been made in recent years in Europe to classify the urban green spaces and green-spots. Using this output, in preparing this report, a uniform classification of sites for potential UEA as well as the associated classification of target green-spots was adopted, with some modifications, for the need of SALUTE4CE project.

Similarly, using the European research achievements of recent years, as well as the good practices of European cities, a uniform classification of Nature Based Solutions (NBS) was adopted. The term "intervention" used in this report should be understood as an action within UEA, which we describe as a transformation of a given type of place (spot) into a given type of green-spot, using such and not others (one or several), types of NBS.

For the comparative assessment of possible types of interventions, a multi-criteria approach was used, distinguishing two large groups of qualitative and quantitative assessment criteria: necessity (benefits of ...) and suitability (favourable/unfavourable conditions). Among the necessity criteria, a lot of space was assigned to issues related to urban ecosystem services, although care was taken not to abuse this terminology. Among the suitability criteria, particular attention was paid to potential conflicts related to land use and urban infrastructure.

Generally, the proposed method and procedure results from state-of-the-art recognition regarding methods of selection for NBS for furnishing or strengthening of the urban green infrastructure. Due to the complexity of the issue, it is recommended that the assessment of possible interventions, followed by the identification of the best, be made by a team of professionals and stakeholders with different competences, so that there is sufficient knowledge regarding environmental, infrastructure, planning and social issues.

An important complement to the proposed methodology for selecting interventions is the proposal for a comprehensive set of rules, including quite detailed ones, regarding the selection of plants for UEA. These principles were selected and formulated in such a way that they would be helpful in planning and implementing interventions for any type of green-spot and for any type of NBS within the SALUTE4CE project profile.

The methodology presented in this report is used to implement Action Plans (AP) for UEA in four FUAs, and it corresponds to the transnational concept of AP (D.T2.1.1).



2. BASIC PRINCIPLES FOR SELECTING THE INTERVENTION SOLUTIONS

- The described method and procedure applies to a single UEA site, previously selected in a manner consistent with that described in D.T1.1.2.
- Information about the place and its surroundings that have determined its election to the UEA Action Plan is still useful, but not sufficient at this stage. They must be supplemented with new aspects and details, and for this digital platforms should be used as much as possible. It may also be appropriate to digitize and introduce data previously obtained in analogous form to the digital platform. Therefore, data collection in "traditional" forms, including those obtained through field visits, should not be neglected.
- Assessment procedures are simple, but specialist interpretation is required to correctly interpret the data necessary to use certain criteria. Therefore, the choice of intervention solution must be made through the team work of several or a dozen people with various competences, both local stakeholders and specialists (scientists, decision makers, urban gardener, architect, landscape architect, lawyer, environmental engineer).
- Each participant in teamwork must have detailed knowledge of the conditions of the place. Such knowledge must go beyond desktop analysis, and knowledge acquired through field visits is particularly important.
- The procedure of selection consists of three main stages, and none of the stages can be skipped (see chapter 3.1, Fig. 1 and Fig. 2).
- The use of standard GIS tools can be very helpful at any stage. Therefore, it is strongly recommended to check available digital platforms in the context of the possibility of their use not only as a data source, but also as analytical tools. The use of InViTo tool should also be considered.
- Both the target green-spot type selection for the site as well as necessity and suitability assessments for NBS are made in the context of current (recent) conditions and in the context of anticipated (prospective) conditions
- The procedure is an essential element in the process of the UEA Action Plan development in the FUA (see chapter 3.2, Fig. 3.)

3. PROCEDURES AND METHODS

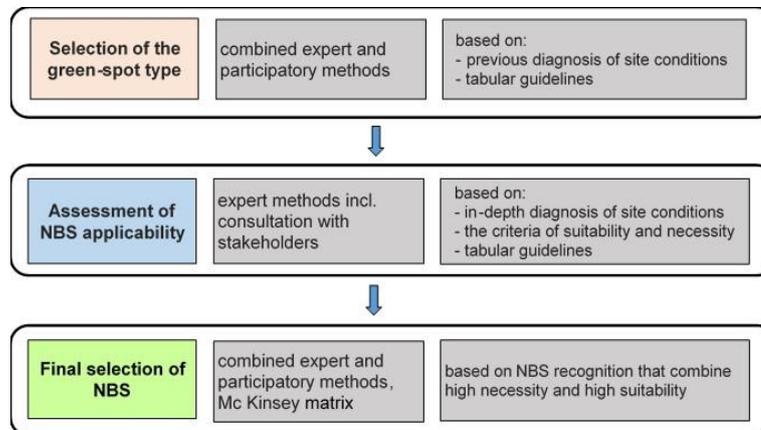
3.1. Outline of the procedure

The procedure of selection consists of following stages (Fig. 1):

- Selection of the green-spot type
- Assessment of NBS applicability
- Final selection of NBS

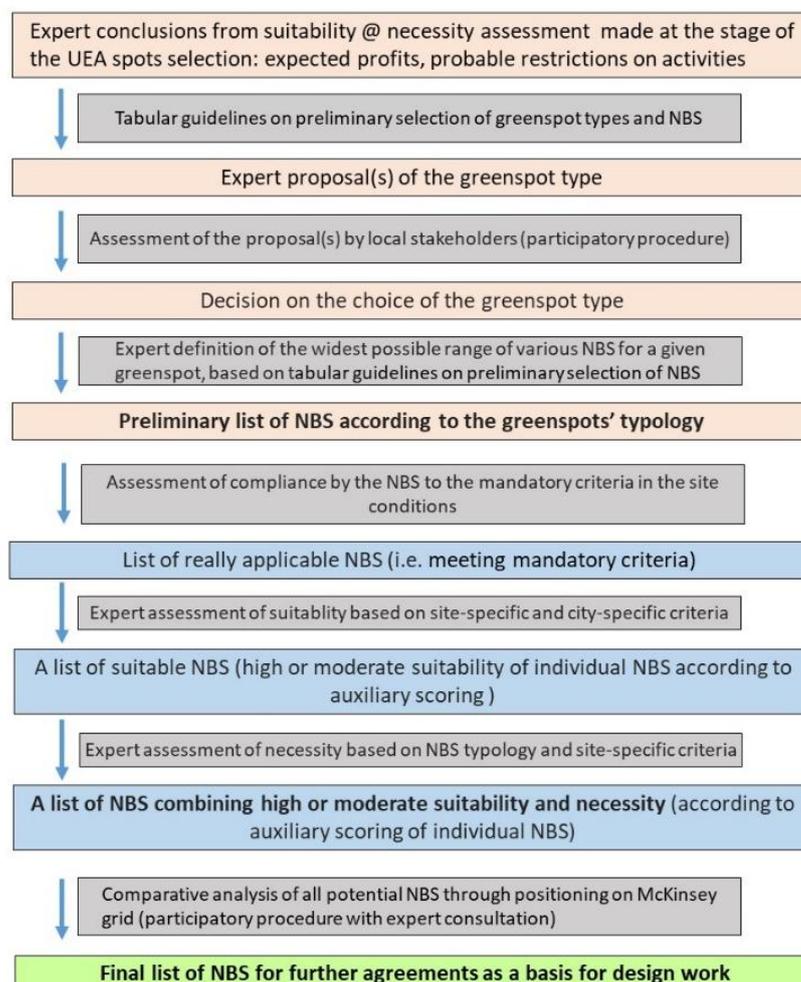


Figure 1. Logic framework for selection of intervention solution on the UEA site



According to the above scheme, an in-depth assessment of the place and selection of solutions is carried out (Figure 2). The introduction to this procedure must be a reference to the results of a site analysis already carried out for the selection of UEA sites (see D.T1.1.1).

Figure 2. Detailed procedure for selection of intervention (target green-spot type + NBS)





3.2. Links to the UEA Action plan in the FUA

The procedure presented in this report, along with the procedure presented in the previous report, is crucial for the 3rd stage of creating the Action Plan (Fig. 3, see also D.T1.1.1, D.T2.1.1). The choice of UEA sites, as well as the choice of intervention solutions should be repeated in the long-term process of implementing the plan, whenever there will be a need to verify the list of places, or to verify solutions, or to verify implementation schedules. However, already at the 1st and 2nd stage of creating the Action Plan (when the initial visions and analyses referring to the FUA scale are created), spatial data and other information very useful for the subsequent selection of UEA sites and even for the selection of intervention solutions are obtained. For the above reasons, it is important that those persons who from the beginning participate in the selection of UEA places and selection of intervention solutions, are also permanently involved in the process of creating and implementing the Action Plan.

Figure 3. Use of the procedure of site selection and selection of intervention solutions in the process of creating and implementing Action Plan.

General steps of Action Plan creation and implementation	The activities under which the selection procedure is carried out (bold); and the activities in which this information is used, which is also required for the selection procedure (<i>italics</i>)
Step 1: Preparation phase	<i>Agreeing upon visions; identifying actors; setting milestones, etc.</i>
Step 2: Analysis phase	<i>Analysing frame conditions, the physical situation, human capital, already existing planning documents, etc.</i>
Step 3: Development phase	Defining (incl. delimitation) areas to be considered in the action plan
	Mapping potential UEA sites in the defined areas (GIS, a long list, datasets, etc.)
	Final selection of UEA sites (a limited number) to be included in the action plan <ul style="list-style-type: none"> ▪ Selection of the green spot type ▪ Assessment of NBS applicability ▪ Final selection of NBS
Plan implementation	<i>"If needed" revision of the UEA sites list or green-spot types or NBS (i.e. repetition of phases 2 & 3)</i>

3.3. Selection of the green-spot type

The methodology for selecting an intervention solution for potential UEA site, which is to be useful for various cities of Central Europe, must refer to the unambiguous classification (typology) of places (green-spots) and the typology of possible solutions. However, such a classification of urban spaces that would be widely accepted does not exist. Among the existing proposals there is no one that is addressed specifically to green-spots. By creating a possibly simple classification of green spots for the needs of the SALUTE4CE project, we tried to take advantage of the already existing typology of urban spaces, including the "green" (or "greened") ones. Analyzing specialist literature and the practice of planning/using greenery in European cities, we remembered that we are interested in objects with a small area, i.e. up to 0.2 ha, located in highly urbanized space with a deficit of greenery, and therefore in the city's core zone rather than in peri-urban zone.



It was very important to note that with the transformation into a green-spot, the conditions and function of a given place in the public space may change radically, and therefore the "type" of the place may change. Examples include: creating a pocket park or urban orchard, community garden, urban woodland etc. It is clear that a given type of green-spot can be created in different locations, but not everywhere. For example, it would not be wise to locate an urban orchard in a pedestrian area nearby on the main street (while this is a typical pocket park location). From these insights, the idea arose to propose a typology that would link the initial image of the place to the target type of green-spot.

Uniform classification of sites for potential UEA as well as the associated classification of target green-spots, developed for the needs of SALUTE4CE project, results from the analysis of many sources. As for the general approach and naming, it is rooted in land-use and land management rather than urban planning. The starting point for our classification was Hofmann's proprietary proposal (Hofmann 2011, 2014). The achievements of two major European Union research projects also have a great impact on our classification: GREENSURGE (Cvejić, Eleret al. 2015), and Urban GreenUP, (González, Pablos et al. 2018). The green-spots' classification should not be confused with that of Nature Based Solutions (NBS). The latter are described in chapter 3.4.

For the purposes of developing UEA Action Plans, we have distinguished 23 types of potential sites and 24 green-spot types (Table 1). It is assumed that in each case the place is publicly available, although it is not a hard condition for it to be in the hands of public entities. Each site type is assigned to one of 5 parent categories. This should make it easier for the user of this document to assign the site to the appropriate type. 20 out of 23 types of places are those that are in daily use, while the last 3 (forming a separate, 5th category) are places for which the implementation of UEA will also mean restoring their use.

In Table 1, the level of recommendation (high, moderate, low) for a given transformation of the place is marked with different colours. These are important guidelines for the team working on the Action Plan, although a "low recommendation" does not necessarily mean that the type of green spot is automatically excluded.

In the process of choosing the green-spot type, a more or less articulated idea about its target functioning in the urban space crystallizes, and usually also some vision of the target image of greenery. It is strongly recommended that such an initial concept be briefly described, visualized, and made available to all persons involved in further work aimed at choosing NBS.

Each decision on the choice of the green-spot type should be based on the professional knowledge of many people as well as a good understanding of the place. The first step on the path should be to formulate - one or several alternative - of expert proposal(s) for the green-spot type. This proposal(s) should be assessed and discussed by local stakeholders (participatory procedure). The final choice of the green-spot type should be the result of agreement among experts and stakeholders.

It should also be borne in mind that for each type of green spot, the limited NBS scope is strongly recommended (see Chapter 3.4). Similarly, for a given type of NBS there are usually only a few strong recommendations as to the green-spot types (see Chapter 3.4). For this reason, in some cases it is worth starting to evaluate possible intervention with the procedure described in chapter 3.4. In this case, the target green-spot type will be defined only after analysing the suitability and necessity of possible NBS. This approach is recommended especially in cases where site conditions may impose a choice among a small number of NBS, while no decision has yet been made as to the future functions of this place in urban space.



Table 1. Types of potential UEA sites vs target green-spot types

Traffic areas + Infrastructure areas					Multifunctional public open areas			Areas for peace / reflection			Greenspot types (the result of UEA application)	
Traffic/ road border + energy line	Walkway, bicycle track	Play street	Car parking space	Boulevard	Pedestrian area in roadside zone	Town square	Riverside	Recreation area (e.g. playground, sport area)	Memorial site	Churchyard (other than a cemetery)		Cemetery or adjacent area
												Greened town square (pedestrian zone)
												Urban woodland
												Greened municipal recreational area
												Multifunctional greened riverside area
												Urban orchard
												Community garden
												Green pedestrian area in roadside zones
												Greened walkway, bicycle track
												Greened play street
												Greened car parking space
												Greened boulevards/ promenades (pedestrian zone)
												Pocket park
												Front garden (in housing area)
												Greened backyard, courtyard
												Green roof/ balcony/ terrace garden
												Green atrium
												Green area adjacent (a.a) to retirement house
												Green a.a. to cultural/ educational facilities
												Educational garden (school or other educational facilities)
												Green a.a. to office buildings, industrial- or business buildings
												Green a.a. to low-rise building estate
												Green a.a. to multistory housing
												Green a.a. to children facilities or youth recreational facilities
												Greened memorial site



Table 1. Types of potential UEA sites vs target green-spot types (cont.)

Areas adjacent (a.a.) to buildings (semi-public or private)							(Semi) abandoned areas			Greenspot types (the result of UEA application)	
A. a. to low-rise building estate	A. a. to office- or industrial or business buildings	Backyard, courtyard	Roof / roof terrace	A. a. to multi-story housing	A. a. to retirement houses	A. a. to cultural/ educational facilities	A. a. to children facilities or youth recreational facilities	Urban wasteland (vacant or derelict areas)	Brownfield sites / conversion area (military with GI potential)		Semi- abandoned green areas (e.g. park, agricultural land, forest)
											Greened town square (pedestrian zone)
											Urban woodland
											Greened municipal recreational area
											Multifunctional greened riverside area
											Urban orchard
											Community garden
											Green pedestrian area in roadside zones
											Greened walkway, bicycle track
											Greened play street
											Greened car parking space
											Greened boulevards/ promenades (pedestrian zone)
											Pocket park
											Front garden (in housing area)
											Greened backyard, courtyard
											Green roof/ balcony/ terrace garden
											Green atrium
											Green area adjacent (a.a) to retirement house
											Green a.a. to cultural/ educational facilities
											Educational garden (school or other educational facilities)
											Green a.a. to office buildings, industrial- or business buildings
											Green a.a. to low-rise building estate
											Green a.a to multistory housing
											Green a.a. to children facilities or youth recreational facilities
											Greened memorial site

 High recommendation

 Moderate recommendation

 Low recommendation



3.4. Assessment of Nature Based Solutions (NBS) applicability

3.4.1. Types of NBS that are recommended for UEA Action Plans

In this report, we use the concept of Nature Based Solutions (NBS) as defined in the annex 1 to the European Commission document dedicated to NBS for cities (Cecci, 2015). This definition is very extensive, and here are some key features of NBS listed there:

- they are actions inspired by, supported by or copied from nature,
- they are created to help society in sustainable ways meet the environmental, social and economic challenges, both using and enhancing existing solutions, as well as exploring more novel solutions,
- they use the features and complex system processes of nature, in order to achieve an environment that improves human well-being and socially inclusive green growth.
- they are resilient to change, as well as energy and resource efficient, but in order to achieve these criteria, they must be adapted to local conditions.

Due to the objectives of the SALUTE4CE project, we aimed to draw up an NBS list that would allow strengthening the city's green infrastructure by operating on a local scale (even on a scale of a single property), and could be introduced in extremely urbanized space. In addition to the above, each NBS must meet the following conditions:

- helps to improve the quality of public space,
- gives a long-lasting effect (at least a of years), while the benefits of its implementation are as comprehensive as possible and are achieved as quickly as possible,
- it is a well-known solution, proven in European cities, which does not require deep expert knowledge,
- it does not create unpredictable conflicts with urban infrastructure,
- requires relatively low costs and labour inputs and costs for implementation and subsequent maintenance,
- it can be easily combined with other NBS, as well as with elements of "gray" urban infrastructure

The list of 30 NBS (Tab. 2) recommended for the SALUTE4CE project Action Plans was developed as a result of in-depth analysis of modern solutions for urban green infrastructure implemented in European cities, the achievements of GREEN SURGE and Urban GreenUP projects, and recognition of the conditions of Central Europe region (among them - those FUAs whose representatives participate in the project SALUTE4CE). Its content was also influenced by the own, many years of professional experience of the authors' team members.

Links to basic information on all these NBSs are provided in the reference list at the end of this report. We especially recommend you to familiarize yourself with the NBS catalogue developed as part of the Urban GreenUP project (González, Pablos et al. 2018), followed by the typology of green spaces proposed in the GREENSURGE project (Cvejić, Eler et al. 2015). These publications contain numerous links for detailed information on individual types of NBS. In addition, as part of the SALUTE4CE (Thematic work package no. 4) project, a handbook on urban environmental acupuncture is being developed, of which the NBS catalogue will be part.



Tabele 2. NBS types useful for transforming the place into an urban green-spot (see also the next pages).

Rooting	NBS name	Definition	Arrangement
ground	Urban meadows	Multi-species plant community of native herbaceous plants in the form of mesotrophic or dry meadow, created in urban space	horizontal
	Verges/flower beds with native perennials	Roadside linear features (verges) or patches (flower beds) of green space of reduced maintenance activities, sown with a wildflower-rich grassland seed mix, to provide nectar and pollen to attract foraging insect pollinator species	
	Ground cover plants	A patch of low vegetation usually one species (perennials or low shrubs), of reduced maintenance activities, tightly and permanently covering bare earth	
	Lawn	An area of soil-covered land, planted with grasses, which are maintained at a short height and used for aesthetic and recreational purposes	
	Green pavements	Pavement with soil-filled gaps, with filter properties and with specific creeping grass species with a short growing and minimum maintenance	
	Street trees	Trees grown and planted in a manner consistent with the standards for street trees	
	Park trees	Trees planted in green (greened) areas other than traffic areas or town squares	
	Fruit trees/shrubs	Trees or shrubs grown for edible fruit or seeds	
	Large shrubs	Shrub species / varieties growing up to a height exceeding 2 m	
	Rain gardens (under-drained)	Shallow basin filled with porous soil mixture and covered with native vegetation capable of phytoremediation, designed for retention, treatment and infiltration of storm-water	
	Road-side swales for retention and infiltration	Grassed open channel designed for reduction runoff volume as well as retention, treatment and infiltration of storm-water	
	Linear wetlands for storm water filtration	Shallow, linear basin with impervious bottom, filled with porous soil/gravel mixture and covered with native vegetation capable of phytoremediation. Designed for treatment and filtration of storm-water through surface and subsurface flow	



	Natural pollinators' modules	Terrestrial micro-habitat (10-20 m ²) designed to attract pollinators (and biodiversity in general), consisting of plants, water source, housing for biodiversity, and site furnishing	
	Hedge/hedgerow	A line of shrubs maintained to form a physical boundary (a hedge), in association with other flora and physical features (a hedgerow)	
	Rockery	Small garden constructed with aesthetically arranged rocks /stones, with small gaps between in which small plants are rooted	
	Herb spiral	Small garden constructed as a raised, cone-shaped spiral bed, incorporating multiple levels, designed to provide herbs with a variety of growing conditions.	
	Urban wilderness/ succession area	A patch of vegetation in the urban tissue, where spontaneous but controlled succession takes place, and maintenance activities aim to ensure the sustainable provision of ES by a multi-species, self-supporting plant community	
	Ground crops of vegetables / herbs	A small garden constructed for soil cultivation (patches, containers) of vegetables/herbs	
	VRSS slopes with green fences	A fence out of wood, covered with climbers and shrubs, situated on vegetated reinforced soil slope (VRSS), functioning as both green safety elements and biodiversity habitat, separating the space for pedestrians or cyclists from the river / ditch.	vertical/ horizontal
	Green pergolas/ green arbors	A structure supporting vines or climbing plants, creating a shaded or semi-shaded space. It is identified by having two or more posts or columns and an open roof. Can be freestanding or attached to a building.	
ground or container	Green facades with climbing plants	A wall completely or partially covered with greenery (twining or clinging self-climbers). It can use a trellis system to hold the plants that are rooted in the ground or containers.	vertical
	Wall-mounted living walls	Structures (continuous or modular) containing organic or inorganic growth media in which plants are rooted, attached to concrete walls. Water and nutrients are supplied using an automated irrigation system).	
container	Hydroponic mobile living walls/vertical gardens	Self-supporting constructive system based on metallic structure equipped with waterproof layer, hydroponic textile substrate for vegetation growth, water collection system and automated irrigation system.	



Vertical vegetable/herb gardens	Vertical free-standing or wall-mounted structures for growing vegetables or herbs outdoors	horizontal
Hanging wall planters (as green street furniture)	Baskets, flower pots, boxes, etc. with decorative perennials, hung on walls, posts, fences, sheds, balustrades, etc.	
Compacted pollinators' module	Micro-habitat (4-5m ²) created in a planter with impervious bottom, designed to attract pollinators (and biodiversity in general), consisting of plants, water source, housing for biodiversity, and site furnishing	
Rain gardens in planter (=self-contained)	A crate / pot with impervious bottom, filled with porous soil mixture and covered with native vegetation capable of phytoremediation, designed for retention and filtration of storm-water	
Street planters (as green street furniture)	Free standing planters of various shapes, sizes, made of various materials, e.g. wood, concrete, metal, recycled plastic, fiberglass. Not only perennials, but also bushes and trees can be planted in street planters	
Green covering shelters	Very light type of green roof covered with very light, thin substrate and small vegetation. Installed on small or big coverage infrastructures, like bus shelter or existing covering shelters.	
Green roof /roof terrace	External upper covering of a building which the main objective is to favour the growth of vegetation. Consists of several layers ensuring water tightness and resistance to the penetration of roots as well as allowing the correct development of the vegetation	

3.4.2. Making preliminary list of NBS according to the green-spots' typology intended to allow

The selection of the target green-spot type and the preliminary determination of its target function does not prejudice the list of NBS implemented. However, a given type of green spot can be attributed, by definition to some NBS. Others types - rather excluded, and others may be more or less useful, depending on the specific conditions of the place. With that in mind, we've decided to make recommendations about NBS pre-selection for a given type of green spot. Recommendations covering 30 NBS types for 24 types of green spots are tabular (Table 3). Using of these recommendations is intended to allow a significant simplification and shortening of the NBS selection process, and at the same time reduce the risk of incorrect selection.

We would like to point out that the recommendations presented in Table 3 do not have a prototype. They result from the analysis of specialist literature and case studies, as well as from personal observations and professional experiences of a small group of authors. For this reason, we assume



that the practice of the coming years, both during the implementation of the SALUTE4CE and projects not related to this one, can still make some adjustments.

In Tab. 3 the level of recommendation (high, moderate, low) for each NBS applications for different types of green-spots is marked with one of three colours (dark green, light green or yellow). These are important guidelines for the team working on the Action Plan, although a "low recommendation" does not necessarily mean, that the type of NBS is automatically excluded. On the other hand, the "high recommendation" does not mean that the NBS must be included in the further analysis. For example, it may turn out that such an NBS clearly does not match the initial vision of the green-spot developed when choosing the green-spot type. It should also be borne in mind that, if the majority of recommendations definitely missed the initial vision of the green spot, then one should consider modifying this vision or even resuming work on the green spot type selection.

Preliminary list of NBS should be based on professional knowledge of many people as well as on good understanding of the place. It should also be consistent with the initial idea/vision of the green-spot. Pre-selection of excessive number of potential NBS should not be avoided. The long list should be the result of agreement among experts.

During the discussion on the preliminary list of NBS, the pre-existing image of the green spot acquires a more specific shape. It is strongly recommended that such a concept should be briefly described and visualized by experts, and made available to all stakeholders involved in further work aimed at NBS selection.



Table 3. Recommendations on the applicability of different types of NBS for different types of green-spots

Greenspot types	Greened town square (pedestrian zone)	Urban forest / woodland	Multifunctional greened riverside area	Greened municipal recreational area	Urban orchard	Community garden	Green pedestrian area in roadside zones	Greened walkway, bicycle track	Greened play street	Greened car parking space	Greened boulevards/ promenades (pedestrian zone)	Pocket park
Possible NBS for a type of greenspot												
Urban wildflower meadows												
Verges / flower beds with native perennials												
Ground cover plants												
Lawns												
Green pavements												
Street trees												
Park trees												
Fruit trees/ shrubs/												
Large shrubs												
Rain gardens (under-drained)												
Road-side swales for retention and infiltration												
Linear wetlands for stormwater filtration												
Natural pollinators' modules												
Hedges/ hedgerows												
Rockery												
Herb spiral												
Urban wilderness / succession area												
Vegetable garden												
VRSS slopes with green fences												
Green pergolas/ green arbors												
Green facades with climbing plants												
Wall-mounted living walls												
Green roof/roofterrace												
Hydroponic mobile living walls / vertical gardens												
Vertical vegetable / herb gardens												
Compacted pollinators' module												
Rain gardens in planter (=self-contained)												
Street planters (as green street furniture)												
Hanging wall planters (as green street furniture)												
Green covering shelters												



Table 3. Recommendations on the applicability of different types of NBS for different types of green-spots (cont.)

Greenspot types	Possible NBS for a type of greenspot											
	Front garden (in housing area)	Greened backyard, courtyard	Green roof/ balcony/ terrace garden	Green atrium	Green a.a. to retirement houses	Green a.a. to cultural/ educational facilities	Educational garden (school or other educational facilities)	Green a.a. to office buildings, industrial- or business buildings	Green a.a. to low-rise building estate	Green a.a. to multistory housing	Green a.a. to children facilities or youth recreational facilities	Greened memorial site
Urban wildflower meadows	High	High	High	High	High	High	High	High	High	High	High	High
Verges / flower beds with native perennials	High	High	High	High	High	High	High	High	High	High	High	High
Ground cover plants	High	High	High	High	High	High	High	High	High	High	High	High
Lawns	High	High	High	High	High	High	High	High	High	High	High	High
Green pavements	High	High	High	High	High	High	High	High	High	High	High	High
Street trees	High	High	High	High	High	High	High	High	High	High	High	High
Park trees	High	High	High	High	High	High	High	High	High	High	High	High
Fruit trees/ shrubs/	High	High	High	High	High	High	High	High	High	High	High	High
Large shrubs	High	High	High	High	High	High	High	High	High	High	High	High
Rain gardens (under-drained)	High	High	High	High	High	High	High	High	High	High	High	High
Road-side swales for retention and infiltration	High	High	High	High	High	High	High	High	High	High	High	High
Linear wetlands for stormwater filtration	High	High	High	High	High	High	High	High	High	High	High	High
Natural pollinators' modules	High	High	High	High	High	High	High	High	High	High	High	High
Hedges/ hedgerows	High	High	High	High	High	High	High	High	High	High	High	High
Rockery	High	High	High	High	High	High	High	High	High	High	High	High
Herb spiral	High	High	High	High	High	High	High	High	High	High	High	High
Urban wilderness / succession area	High	High	High	High	High	High	High	High	High	High	High	High
Vegetable garden	High	High	High	High	High	High	High	High	High	High	High	High
VRSS slopes with green fences	High	High	High	High	High	High	High	High	High	High	High	High
Green pergolas/ green arbors	High	High	High	High	High	High	High	High	High	High	High	High
Green facades with climbing plants	High	High	High	High	High	High	High	High	High	High	High	High
Wall-mounted living walls	High	High	High	High	High	High	High	High	High	High	High	High
Green roof /roof terrace	High	High	High	High	High	High	High	High	High	High	High	High
Hydroponic mobile living walls / vertical gardens	High	High	High	High	High	High	High	High	High	High	High	High
Vertical vegetable / herb gardens	High	High	High	High	High	High	High	High	High	High	High	High
Compacted pollinators' module	High	High	High	High	High	High	High	High	High	High	High	High
Rain gardens in planter (=self-contained)	High	High	High	High	High	High	High	High	High	High	High	High
Street planters (as green street furniture)	High	High	High	High	High	High	High	High	High	High	High	High
Hanging wall planters (as green street furniture)	High	High	High	High	High	High	High	High	High	High	High	High
Green covering shelters	High	High	High	High	High	High	High	High	High	High	High	High

High recommendation

Moderate recommendation

Low recommendation



3.4.3. Assessment of compliance of the NBS to the mandatory criteria in the site conditions

The preliminary, long list of NBS should be the subject of in-depth analysis in the context of mandatory criteria. To this end, each potential NBS should first be confronted with a list of mandatory criteria, which **MUST** be all complete so that the NBS may be subject to further evaluation. To qualify a NBS for further analysis, it is necessary that it meets all of the following admission criteria (failure to meet even one of the criteria results in elimination from further analysis):

- Clear path of arrangements/permits for this type of NBS
- No irreversible conflicts of this type of NBS with underground or overhead facilities (neither planned nor already existing)
- Sufficient space for a given NBS, both for the implementation of executive work and for the subsequent functioning of the green spot
- No contradiction with applicable plans/programs/projects to which the place is covered (contradiction occurs when in the light of strategic/planning documents or for technical/architectural reasons, this kind of NBS is not allowed in this place)
- No explicit conflicts with local stakeholders for this type of intervention.

The list of NBS verified in this way is the starting point for expert assessment of suitability based on site-specific and city-specific criteria.

3.4.4. Expert assessment of NBS suitability

Further detailed assessment of NBS suitability should take into account not only the conditions resulting from the current use of the land, but also the ones predicted in the time horizon of the prospective analysis. The simplest and recommended approach involves directly using the criteria set out in Table 4. According to this approach, the suitability of each NBS analysed is reflected by scoring.

Table 4. Framework for expert assessment of the suitability of a given NBS in a given site, based on NBS typology and site-specific criteria: obstacles/restrictions to be overcome. The table was developed on the basis of literature data and as a result of consultations with the project SALUTE4CE partners.

Conditions for implementing a given NBS in a given site	Scoring [0-2] points	The type of criteria
Expected difficult / time-consuming procedures of arrangements / permits, necessary for taking the NBS type	2 - not occurring or insignificant, 1 - moderate, 0 - big	City-specific
Potential conflicts of the NBS with existing facilities, possible to overcome but requiring additional technical designs and/or additional arrangements/permits	2 - not occurring or insignificant, 1 - moderate, 0 - big	Site-specific
Due to the conditions of the site, expected necessary additional cost-consuming or time-consuming preparatory work for the NBS type	2 - not occurring or insignificant, 1 - moderate, 0 - big	Site-specific



Due to the conditions of the site, expected higher labour-consuming and/or cost-consuming maintenance compared to typical for a particular type of NBS	2 - not occurring or insignificant, 1 - moderate, 0 - big	Site-specific
Unclear scope of competences and unclear obligations in the scope of maintenance of a given NBS type	2 - not occurring or insignificant, 1 - moderate, 0 - big	City-specific
Deficiency of practical experience / shortage of designers/shortage of technical teams that could implement this type of NBS	2 - not occurring or insignificant, 1 - moderate, 0 - big	City-specific
Presumed difficulty in financing the type of NBS (e.g. due to lack of funds in the city budget for a given type of NBS, or difficulty in obtaining external funds)	2 - not occurring or insignificant, 1 - moderate, 0 - big	City-specific
Highly likely lack of acceptance of local community for this type of NBS	2 - not occurring or insignificant, 1 - moderate, 0 - big	Site-specific
Compatibility of a given NBS type with the type of green-spot	2 - high recommendation; 1 - moderate recommendation; 0 - low recommendation	Predefined by the recommendations (see Tab. 3)

Warning:

- the total score is the sum of points for individual criteria
- scores for each criteria should be gradable (0/1/2)
- different weights can be assigned to different criteria depending on the specifics of a given FUA (for a given site)

The result of the verification carried out according to the criteria presented in Table 4 is the list of suitable NBS (high or moderate suitability of individual NBS according to auxiliary scoring). Such a list is the starting point for expert assessment of necessity based on NBS typology and site-specific criteria.

3.4.5. Expert assessment of NBS necessity

Further detailed assessment of NBS necessity should take into account not only the needs arising from the current use of land, but also the projected prospective analysis over the time horizon. The simplest and recommended approach involves directly using the criteria set out in Table 4. According to this approach, the necessity of each NBS analysed is reflected by scoring.



Table 5. Framework for expert assessment of the necessity of a given NBS in a given site, based on NBS typology and site-specific criteria. The table was developed on the basis of literature data and as a result of consultations with the project SALUTE4CE partners.

Necessity for:	A list of possible benefits of UEA	Scoring [0-5] possible benefits of implementing a given NBS on a given site	Weight (between 0 and 1): importance (priority) of a given type of benefit for a given site
Microclimate / air quality	<p>Reducing exposure of people to the heat island effect (incl. providing climate refuges for vulnerable resident populations),</p> <p>Improvement of air quality (removing air pollutants, slowing down the creation of secondary pollutants, increasing oxygen concentration),</p> <p>Reduction of noise</p>	<p>The score depends on:</p> <ul style="list-style-type: none"> - predefined greatest possible benefit of the NBS (see Tab.6)1 - probable share of the NBS in the future greenery of the site 	<p>Site-specific, does not depend on the NBS concerned</p>
Water management	<p>Improving rainwater management (by local use of excess rainwater, or infiltration to the ground, or local retention)</p> <p>Linking green space with storm-water infrastructure</p> <p>Decreasing the amount of impervious surface</p>	<p>The score depends on:</p> <ul style="list-style-type: none"> - predefined greatest possible benefit of the NBS (see Tab.6)2 - probable share of the NBS in the future greenery of the site 	<p>Site-specific, does not depend on the NBS concerned</p>
Green space management	<p>Creating (or protecting) areas of low intensity management and relatively low cost of maintenance, where nature can ‘run wild’ and species can establish themselves spontaneously;</p> <p>Promoting heat-tolerant and draught-tolerant species/varieties</p> <p>Supporting a local NGO or citizens’ initiative to maintain green spaces</p>	<p>The score depends on:</p> <ul style="list-style-type: none"> - predefined greatest possible benefit of the NBS (see Tab.6)3 - probable share of the NBS in the future greenery of the site 	<p>Site-specific, does not depend on the NBS concerned</p>

¹ Scoring should not be higher than that predefined in Table 6 - the column “Microclimate/air quality”

² Scoring should not be higher than that predefined in Table 6 - the column “Water management”

³ Scoring should not be higher than that predefined in Table 6 - the column “Green space management”



<p>Biodiversity</p>	<p>Increasing of urban biodiversity (e.g. introduction of native plant species, elimination of invasive plant species).</p> <p>Providing the nutrition functions for wildlife (small animals incl. butterflies and other pollinators, or small birds);</p> <p>Protecting and enhancing native biotopes, especially those that are ecologically significant and threatened</p> <p>Increasing urban soil protection/ regeneration</p>	<p>The score depends on:</p> <ul style="list-style-type: none"> - predefined greatest possible benefit of the NBS (see Tab.6)⁴ - probable share of the NBS in the future greenery of the site 	<p>Site-specific, does not depend on the NBS concerned</p>
<p>Quality of stay</p>	<p>Increasing synergies between different functions, reduction of conflicts</p> <p>Objectively increasing the safety of staying in a given site</p> <p>Increasing (or creating) the visual appeal of the site;</p> <p>Increasing multifunctionality of public space at the site)</p>	<p>Scoring as a consensus among experts and stakeholders (subjective assessment, participatory procedure)</p>	<p>Site-specific, does not depend on the NBS concerned</p>
<p>Integration of the local community</p>	<p>Creating "neighbourhood spaces" for spending free time and socialization;</p> <p>Increasing sense of security;</p> <p>Creating a positive identity of the place and its vicinities;</p> <p>Improving the attractiveness of the site for elderly, mothers with children and/or disabled persons</p>	<p>Scoring as a consensus among experts and stakeholders (subjective assessment, participatory procedure)</p>	<p>Site-specific, does not depend on the NBS concerned</p>
<p>Functional diversity of public spaces</p>	<p>Increasing functional coherence of a network consisting of various types of public spaces;</p> <p>Spatial/functional linking with already existing or planned blue or green areas / green spots</p> <p>Increasing quality / coherence of urban Green Infrastructure network at the city or FUA scale</p>	<p>Scoring as a consensus among experts and stakeholders (subjective assessment, participatory procedure)</p>	<p>Site-specific, does not depend on the NBS concerned</p>

⁴ Scoring should not be higher than that predefined in Table 6 - the column "Biodiversity"



Warning:

- Scoring for particular criteria should not be higher than that predefined in Table 6
- predefined greatest possible benefit of the NBS (see Tab.6)
- the total score is the sum of points for individual criteria
- scores for each criteria should be gradable (0/1/2/3/4/5)
- different weights can be assigned to different criteria depending on the specifics of a given FUA (for a given site)

The criteria presented in Table 5 refer to benefits related to ecosystem services. The scope of benefits of implementing a given NBS always depends on the specifics of the place. However, for the first four criteria, the extent of the benefits is largely due to the type of solution itself. Based on the analysis of specialist literature and case studies, as well as on own professional experience, we proposed an auxiliary statement (Table 6) specifying the maximum benefits of implementing a given type of NBS, expressed in point values. The values assigned in Table 6 to individual NBS should significantly facilitate the necessity assessment carried out using the criteria in Table 5.



Table 6. maximum benefits of implementing individual types of NBS

NBS type	Maximum benefits			
	Microclimate / air quality	Water management	Green space management	Biodiversity
Urban wildflower meadows	2	1	3	5
Verges / flower beds with native perennials	2	1	4	5
Ground cover plants	2	1	5	3
Lawns	2	1	1	1
Green pavements	1	4	4	1
Street trees	5	5	3	4
Park trees	5	5	4	5
Urban wilderness / succession area	4	3	5	5
Ground crops of vegetables/ herbs	2	1	1	2
VRSS slopes with green fences	4	4	4	5
Green pergolas/ green arbors	4	1	3	2
Green facades with climbing plants	5	3	4	3
Wall-mounted living walls	5	1	3	3
Green roof /roof terrace	5	3	4	4
Hydroponic mobile living walls / vertical gardens	5	0	2	1
Vertical vegetable / herb gardens	2	0	1	1
Compacted pollinators' module	5	4	4	5
Rain gardens in planter (=self-contained)	4	5	4	4
Street planters (as green street furniture)	3	0	2	2
Hanging wall planters (as green street furniture)	2	0	1	1
Green covering shelters	5	3	4	3

The result of the verification carried out according to the criteria presented in Tables: 4, 5 and 6 is a list of NBS combining high or moderate suitability and necessity (according to auxiliary scoring of individual NBS). Such a list is the starting point for expert assessment of necessity based on NBS typology and site-specific criteria. This is the starting point for elaboration of final list of NBS.



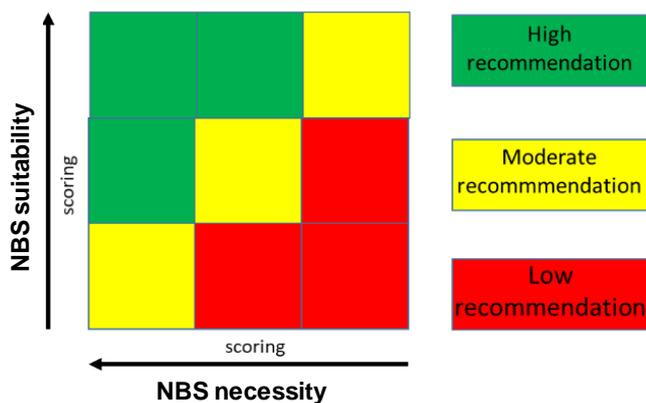
3.4.6. Final selection of NBS

Team expert work on the necessity and suitability assessment of individual NBS leads not only to the verification of the initial NBS list, but also to the development and refinement of the already existing initial vision of the green spot. It is strongly recommended to briefly describe, draw and then analyze this completed vision together with stakeholders. It is about finding potential conflicts between NBS and identifying mutually exclusive NBS. Potential conflicts between NBS that may appear immediately or over the years are, for example, plant competition for light, or difficulty in accessing maintenance/care work. One should also take into account the possibility of conflict consisting in the fact that the implementation of such and no other combination of several types of NBS will cause deterioration of the functionality of the green spot over the years. You should also check if some NBS are mutually exclusive, as they are alternatives for exactly the same place (e.g. green covering shelters vs street trees, or ground cover plants vs urban flower meadow).

If the team of experts and stakeholders comes to the conclusion that all NBS indicated in the manner described in chapters 3.4.4 & 3.4.5 are free from potential conflicts and are complementary and not mutually exclusive solutions, then this NBS list can be accepted as the final one. Conversely, if the need to choose between several NBS mutually exclusive or between NBS whose proximity may conflict arose, a procedure should be used to facilitate consensus.

In some cases, especially when there is a need to choose from more than two NBS, a tool to facilitate consensus may be Mc Kinsey Matrix (GE) (Fig. 4). Similarly, as presented in Deliverable D.T1.1.1 (there was selection of UEA sites), each potential NBS is evaluated by the criteria of necessity and suitability, and then positioned on the Mc Kinsey matrix.

Fig. 4. Mc Kinsey Matrix (GE) in application to final selection among alternative NBS.



Each analysed potential NBS is reflected by scoring - as a point in the matrix area - in the green, yellow or red field. The location of threshold values can be arbitrary and result from the adopted needs / assumptions of the analysis. Assigning a given NBS to the red field means definitive rejection and exclusion from final list. Assignment to a green or yellow field means placing on the candidates for inclusion in the final list.

The same criteria as described in chapters 3.4.4 and 3.4.5 of this report should be used, however:

- NBS score may be slightly different according to some criteria than at an earlier stage of the analysis, and this is because the concept of the green spot has been refined and we now know more about expected benefits and potential conflicts



- different weights can be assigned to different criteria depending on the specifics of a given case

4. PLANT SELECTION RECOMMENDATIONS FOR UEA

4.1. Selection of plant species and varieties

4.1.1. General recommendations

- Selection of plant species and varieties, and their combinations, must be consistent with the specifics of a given site and the specifics of the type of intervention - i.e. the type of green-spot and types of NBS.
- The selection of plants should be limited to those species and varieties for which habitat requirements, impacts on other plants, humans, animals and infrastructure, as well as their growth rate, target habit, target size and required care are fully understood
- In order to permanently fulfil the target functions of greenery in the selection of species and varieties it is necessary to take into account in-depth recognition of:
 - > social needs and expected benefits for the local community,
 - > environmental conditions and biodiversity issues,
 - > already existing plant cover at the site,
 - > available space as well as current and planned infrastructure,
 - > formal and legal restrictions,
 - > availability of specialists with practical knowledge in FUA, for the introduction as well as subsequent care of such plants,
 - > expected long-term cost of greenery introduction and care,
 - > requirements of aesthetics of the place and urban landscape,
- Avoiding, also in the long run, the use of space, high labour intensity and high cost of plant care.
- In each practical case, the possibility of adapting existing plant cover elements, including spontaneously shaped, to the target functions should be considered.
- When selecting plant material, both the short and medium and long term use prospects of the adopted solutions should be taken into account.

4.1.2. Specific recommendations

4.1.2.1. Matching environmental conditions

- The compatibility of the species or variety with local conditions must be taken into account:
 - > soil fertility, depth, texture, type and degree of pollution, permeability, water holding capacity



- > soil moisture and availability of irrigation, water
 - > access to sunlight
 - > exposure to strong wind and prevailing ventilation conditions
 - > the possibility of replacing or improving the ground (soil),
 - > the possibility of cultivation without ground contact (vertical NBS, green roofs, plants in containers)
 - > the hardiness zone in which the FUA is located
- There should be preferred these species and varieties that possible combine:
 - > a wide range of tolerance to extreme temperatures - both high and early spring cold
 - > tolerance to extremely changing humidity conditions (long periods of rainless, heavy rains)
 - > resistance to strong wind
 - > low soil requirements
 - > low requirements for lighting conditions (wide range of tolerance)
 - To reduce the risk of failure, preference should be given to those species and varieties that:
 - > are known for being readily accepted in a new place (high plantability).
 - > are already tested in practice in a given FUA under similar conditions
 - In the case of planting or sowing herbaceous plants (meadow, verge, green roof, lawn, pollinator's modules etc.), as far as possible, authorized, multi-species mixes adapted to the specificity of a given FUA and urban conditions should be used.

4.1.2.2. Expected benefits in terms of regulative ecosystem services (ES)

There should be preferred these species and varieties that possible combine:

- improving the conditions of air circulation (ventilation of the city)
- reduction of air pollution
- limiting the spread of noise
- reduction of the UHI effect

There should be preferred those species whose use will be maximally beneficial for rainwater management.

- On heavily contaminated soil, or in the case of rainwater pre-treatment (e.g. rain gardens, linear wetlands), plants with recognized phytoremediation properties should be preferred.
- In some circumstances, possibility of use plants as a bioindicators can be a selection criterion(e.g. air quality).



4.1.2.3. Compliance with the needs of protecting and strengthening biodiversity

There should be preferred:

- native species and, secondly, species of foreign origin but permanently inscribed in the urban landscapes of the region, provided that they have low expansiveness potential
- plant species or multi-species sets forming habitat and food base for small animals, including birds and pollinating insects
- plant species and multi-species sets, with proven ability to limit the expansion of wild-growing invasive plant species
- multi-species sets, providing long-term benefit for pollinators, from early spring to autumn

4.1.2.4. Promoting expected social benefits

There should be preferred these species and varieties that possible combine the following features:

- provide the comfort of stay to the greatest extent, thanks to the local reduction of the heat island effect, local reduction of other onerous environmental factors, and also due to the improvement of aesthetic values of a given place
- possibly improve the visual attractiveness of urban space, especially in reference to the local cultural heritage or urban layout
- provide the widest possible range of benefits attributable to given type of green spot and given type of NBS
- promote the multi-functionality of public space in UEA site and in its surroundings
- ensure the maturity of the adopted solution as quickly as possible (the maturity understood as the capability to provide the target range of ecosystem services)
- help to underline symbolic values of the site
- have decorative qualities (flowers, leaves, fruits, bark, habit) for the longest possible period of the season

4.1.2.5. Conflicts / risk avoidance

The selection of plants should be limited to those species and varieties that meet the full set of the following conditions:

- compliance with regulations regarding the avoidance of conflicts with infrastructure
- not causing difficulties / nuisances in the daily use of adjacent areas
- not creating threats resulting from the properties of plants (fragile branches, the possibility of secretion, poisoning, etc.)
- not creating danger to people in connection with plant care or technical service of the site, -
- not creating obstacles / barriers for necessary works related to maintenance or reconstruction of technical infrastructure, both above-ground and underground



4.1.2.6. Facilitating further maintenance of the UEA site

When choosing plant material among species and varieties with similar properties, preference should be given to those species or varieties:

- whose care requires less labour, lower costs and less expertise.
- which has less tendency for uncontrolled expansion in urban space
- whose planting creates a chance for greater durability of a given solution and its functioning without the need for major renovation works
- for which any errors or failure to care do not cause significant losses or risks
- whose care will not include work at height

4.1.3. Required properties of the plant material

- The material should:
 - > be certified, comply with the provisions / recommendations in force in the given FUA,
 - > be of the highest quality, free from defects identified as being unacceptable in accordance with existing regulations, standards and recommendations.
 - > come only from authorized sources
 - > be fully labelled according to local regulations
 - > licensed varieties should be purchased based on the presentation of license documentation
- Plant material must be properly protected during transport and storage
- Having an excess of plant material of a given species or variety at hand, should be preferred the one that gives the chance to achieve the target dimensions and ability to perform the intended features faster
- For planting native species, plant material produced from a local nurseries, or from wild population that is as close as possible to the FUA should be preferred.
- For planting on very poor urban soils, plant material produced on appropriately weak soils (pre-adapted) is preferred.
- For trees, shrubs and creepers:
 - > the material must be formed in the nursery in a manner adequate to the end use at UEA site
 - > morphological features, dendrometric parameters and parameters of the root ball must comply with applicable regulations, standards and recommendations for urban plantings
 - > Plants delivered in containers: The obligatory condition is that such a plant was grown in the container from the beginning. In this case, the container parameters and its symbol must be indicated on the label.

4.1.4. General recommendations for limiting or excluding plant species or varieties.

The planting / sowing of plants having any of the following properties should be limited, and in many cases excluded:



- poisonous or irritating to the skin or respiratory system, eyes
- producing poisonous fruits / seeds encouraging with their appearance to pick and eat
- particularly strongly allergenic
- toxic to pollinators
- very thorny
- particularly adversely affecting other plants (strong competitive effects or negative allelopathy)
- particularly susceptible to pests
- requiring unique knowledge and skills in care
- expansive and with significant invasive potential
- for vertical solutions: climbers aggressive to walls / facades.
- species whose fruit causes dirt (e.g. cherry or black mulberry fruit falling on pavements or cafe umbrellas)

5. CONCLUSION

Methodology of selection of solutions for UEA is the next step in creation of UEA system for a functional urban area. It is the step following the initial selection of spots in the previous stage which then was followed by a final selection of sites meeting high necessity and high suitability for UEA implementation (see D.T1.1.1 Methodology of selection of spots for urban environmental acupuncture).

The procedure of selection of intervention type on the UEA site includes following steps:

- Selection of the green-spot type based on previous diagnosis of site conditions,
- Assessment of nature based solution (NBS) applicability based on in-depth diagnosis of site conditions and the criteria of suitability and necessity
- Final selection of NBS based on NBS recognition that combine high necessity and high suitability.

The intervention has been defined as a green-spot type + NBS. This report proposes a list of 24 types of green-spots that can be the subject of UEA. A list of 30 types of NBS has also been proposed that can be recommended for use with different green spots.

The presented methodology can be used in various FUAs in the CE area, wherever there are no large areas for planting greenery. It includes various types of expected benefits, such as integration of local community, functionality of public space, life quality, but also benefits for biodiversity, infrastructure, and land management. Therefore, in addition to action plans similar to the SALUTE4CE project, it can be useful, for example, in activities regarding urban revitalisation, climate change adaptation, urban renaissance, urban green infrastructure etc.

The selection procedure always requires:

- recognition of current and future conditions of the FUA area based on all available information, using, as far as possible, decision support tools available in the digital space.
- social participation



- integration of expert knowledge in various fields (social, environmental, urban, legal, etc.)

For the above reasons, its use can contribute not only to improvement of the quality of public spaces, but also to the dissemination of participative approach to public space management.

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7. GLOSSARY

Action Plan (AP) - a written document that describes how a specific set of actions are to take place in order to bring certain goals and / or visions to fruition. In case of SALUTE4CE project, individual APs - based on common, transnational concept - aid in implementation of measures needed to create small green-spots within the four FUA's. Each AP is being used to identify the specific tasks, timelines, and resources necessary for implementation. It also activates the community's vision by enabling the desired outcomes appropriate to the people and place, including the protection of natural landscapes.

green-spot - a place (usually with an area of no more than 0.2 ha) where one or more NBS solutions will be applied. The green-spots classification should not be confused with that of Nature Based Solutions (NBS)

intervention -used in this report should be understood as an action within UEA, which we describe as a transformation of a given type of place (spot) into a given type of green-spot, using such and not others (one or several), types of NBS.

Nature Base Solution (NBS) - actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits



Urban Environmental Acupuncture (UEA) - intervention or the system of interventions in the selected points of urban fabric with social, economic, ecological or other potential in order to activate their “energy” and affect the surrounding territories