Urban spaces – enhancing the attractiveness and quality of the urban environment

WP3 Joint Strategy
Activity 3.2 Criteria and Principles
Sub-activity 3.2.1 Environmental Criteria

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November 2009
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“It is difficult to design a space that will not attract people. What is remarkable is how often this has been accomplished.”

William H. Whyte

Introduction

The open spaces are the vital elements of all cities and municipalities and are representing an essential part of the basic infrastructure of all urban areas. Open spaces can be seen as a key cross-cutting issue within the general framework of sustainability. A possible vision is that open urban spaces could represent comprehensive networks of accessible, high quality spaces that are (among others) delivering important secondary benefits for local people and, where appropriate, bio-diversity and wildlife.¹

Unfortunately, many negative trends, along with excessive growth of cities, can be monitored within the structure of cities. Preferring economic and other interests causes the decrease of natural components – green areas. This is partially due to the lack of national legislation with regards to the protection of open spaces² and due to the existing legal framework and planning instruments that are not adapted sufficiently to the new cities development.³

The environmental and ecological importance of the open spaces, especially green spaces, is one of the aspect the mostly recognized among other aspects of the open urban spaces. The environmental importance is underlined also by their potential to mitigate adverse effects of climate change, which are likely to be especially marked in urban areas.


² UrbSpace questionnaire 3.1.2, elaborated by REC Slovakia

³ Project URGE – Development of urban green Spaces to improve the quality of life in cities and urban regions, p.97, http://www.urge-project.ufz.de
The environmental aspects of open urban spaces are also stressed in many European policies, e.g. Leipzig Charter, Aalborg Charter of European Cities & Towns towards Sustainability, Thematic Strategy on Urban Environment, the Sixth Environment Action Programme, the renewed strategy for sustainable development, European Landscape convention and were already explored through many European projects⁴. This is one of the reasons why we do not focus in this document solely on description of particular favourable impacts of green spaces on a city’s microclimate. Our effort was rather to concentrate on less known areas, e.g. biodiversity and ecosystem services in relation to open urban spaces, threats to the environment and biodiversity in cities due to climate changes and fragmentation of the natural environment and on environmental aspects of local systems and interconnections among particular open urban spaces. We were also trying to deal with the environmental aspect of open urban spaces in relation to some trends in urban development, such as demographic development and changing in social structures in the cities⁵.

1. Theoretical section dealing with the issues covered by the subject of the working paper

1.1 Introduction

When defining the basic environmental aspects of open urban spaces it was necessary to carry out a finer division, especially from the point of view of their functions, hierarchy, scale, importance, etc. In accordance with the definition of open urban spaces as defined in Appendix C to the questionnaire 3.1.1 elaborated by TU Vienna, that “Open space” is any un-built land within the boundary of an urban area which provides, or has the potential to provide, environmental, social and/or economic benefits to communities, whether direct or indirect⁴ we have categorised in one group the greenspaces

⁴ URGE, RUROS, BUGS
⁵ Ensuring quality of life in Europe’s cities and towns, Tackling the environmental challenges driven by European and global change, EEA report, 2009
with prevailing vegetation and nature components (natural or anthropogenic) and the urban spaces with prevailing components of technical nature:

- **Greenspace**: a sub-set of open space, consisting of any vegetated land or structure, water or geological feature within urban areas

- **Civic space**: a sub-set of open space, consisting of urban squares, market places and other paved or hard landscaped areas with a civic function\(^6\)

Suitable hierarchies can encompass open spaces at different scales, with different catchment areas, serving different purposes, with different types of open spaces (greenspaces and civic spaces), different ranges of facilities and different management and maintenance regimes – **and these all issues shall be taken into consideration when trying to define** basic environmental aspects of open urban spaces.

We suggest for the UrbSpace project purposes the **three-level hierarchy** relating to open spaces:

- **City (Strategic) significance**; these open spaces attract the highest number of users, mainly from throughout the local authority area but possibly wider area, and therefore, have a large effective catchment and high distance threshold. A high proportion of users is likely to travel to them by car or public transport.

- **District (Middle order) significance**; these open spaces will tend to attract a significant proportion of their users from particular parts of the local authority area e.g., at least two neighbourhoods (in urban area).

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\(^6\) RETHINKING OPEN SPACE OPEN SPACE PROVISION AND MANAGEMENT: A WAY FORWARD, Kit Campbell Associates, Edinburgh, The Scottish Executive Central Research Unit 2001, chapter 5.6
• **Local (Neighbourhood) significance:** smaller area which will tend to attract almost all of their users from a particular area such as a single neighbourhood. Many users of these facilities will walk to them.

The issue of the hierarchy has to be linked directly to the issue of map scale. *City significance should be taken into account when defining the environmental criteria at city level. When it comes to District (Middle order) significance, it is necessary to define the environmental aspect at district level and in the case of local (Neighbourhood) significance, the environmental aspect is defined at local level.*

Moreover, the importance of particular open urban spaces is often linked to their functions and maintenance costs. Generally, it is possible to say that the strongly urbanized city centres include mainly the open urban spaces (both greenspaces and civic spaces) of higher importance (city significance) and with higher maintenance costs (representative squares and monument zones). In peripheral urban areas there are open urban spaces of local/district importance or greenspaces of more natural character. Excessive urban sprawl often causes problems in defining the physical border of the city. According to a number of authors and works in the area of spatial planning (e.g. O. Bounsted, 1953)\(^8\) the city can be divided to individual parts on the basis of a concentric circles model with a clear gradient from the city core to its peripheral parts. In accordance with this model the city can be divided to:

- core of city,
- urbanised parts of city,
- peripheral parts of city.

This division of city can be monitored on the basis of a number of indicators, such as population density, number of inhabitants commuting to work to the centre, share of non-agricultural economic activities in the framework of overall economic structure of

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\(^7\) Open Space Strategy, London Borough of Sutton, 2007

\(^8\) Published in “Selected Method and Models for Analysing Processes in Urban Regions”, Vienna 2002.
population. Based on evaluation of these indicators it is possible to more clearly define the border between urban and rural environment.

Open urban spaces should be able to achieve physical and functional connectivity between sites at all levels and right across a town, city or sub-region. It is vital that each individual open space (with specific functions) is a part of a larger network and that a open space network incorporates all the open spaces of a town or city, both public and private. Connectivity may not always mean a direct physical connection between sites, although a physically joined-up network should dominate.

Moreover, when defining the environmental aspect it is necessary to deal with development trends and threats, such as climate change, biodiversity loss, changes in social and age structure of cities, etc.

1.2 Theoretical section

Principal aspects of the open urban spaces from the environmental and ecological point of view are as follows:

- Climatic amelioration of the urban environment
- Biodiversity conservation
- Ecological services
- Threats to the urban environment and urban biodiversity - climate change, fragmentation and connectivity, affecting the hydrological cycle – tackling storm rainfall problems
- Some indirect aspects related to the sustainable development – e.g. environmental education, health of the population, etc.
1.2.1 Climatic amelioration of the urban environment

Already today the urban environment differs from surrounding landscape in a number of characteristics (temperature, humidity, air quality, etc.). The open spaces, especially the greenspaces are playing the principal role to moderate these characteristics.

Picture 1. Aerial shots by thermovisual camera – demonstration of difference in temperatures depending on type of urban landscape structure, surface and amount of vegetation

**Temperature characteristics in cities, precipitation, air quality, etc**

Air temperature is the most important characteristic of climate. In urban settlements there is high concentration of surfaces with large thermal capacity which are strongly warmed up. This causes considerable heat accumulation in cities. Temperature growth is also affected by the heat released from industrial processes, combusting engines in transport and the heating of residential houses. Common influence of these factors leads to creation of so called “heat islands”.

According to data from literature, **temperature difference between city and its surroundings** is approximately **0.5 to 1.5°C**. This, at the first glance negligible, difference in temperatures means relative change of altitude by 100 to 300 metres and a **shift by one vegetation level**. Therefore species from Mediterranean and continental areas are more appropriate in dry urban biotopes. Increased friction on rangy terrain worsens

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9 Hudekova, Z. Et al:
movement of air up to the altitude of 1,000 metres over the city. Over the city the air layers warm up and together with presence of condensation nuclei (dust and aerosol) help to increase cloudiness over cities as compared to surrounding landscape. Annually this difference is 5 to 10 %. Increased cloudiness leads to increased rainfall, but impermeable surfaces in cities and sewerage systems rapidly take the water away from the territory.

Table 1: Basic climatic characteristics of the urban environment and comparison with surrounding landscape\textsuperscript{10, 11}:

<table>
<thead>
<tr>
<th>climate characteristic</th>
<th>difference between city and surroundings</th>
<th>volume of difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>air temperature</td>
<td>+</td>
<td>0.5 to 3 °C\textsuperscript{9, 10}, 2-6 °C\textsuperscript{10}</td>
</tr>
<tr>
<td>cloudiness</td>
<td>+</td>
<td>5 to 10 %</td>
</tr>
<tr>
<td>rainfall total</td>
<td>+</td>
<td>5 to 20 %</td>
</tr>
<tr>
<td>fog incidence</td>
<td>+</td>
<td>30 to 100 %</td>
</tr>
<tr>
<td>average air humidity</td>
<td>-</td>
<td>20-60%</td>
</tr>
<tr>
<td>duration of snow cap</td>
<td>-</td>
<td>2 to 18 days</td>
</tr>
<tr>
<td>solar radiation</td>
<td>-</td>
<td>10 to 30 %</td>
</tr>
</tbody>
</table>

\textsuperscript{10} Supuka J. et al.: Ecological principles of green area management. VEDA, Bratislava 1991.
\textsuperscript{11} EEA: Europe’s Environment: Dobřiš Assessment (modified), 1995.
Polluted air over cities reduces the amount of solar radiation and an average city receives less solar radiation by 15 % when compared to open country. In winter months this decrease is even 30 %. Table 1 shows the most important climate characteristics of the urban environment and difference from surrounding landscape.

Air quality in cities is diverse, depending on density of activities, used fuels and industrial technologies. Various technological processes, transport and housing emit various gaseous chemical compounds, such as carbon oxides, sulphur oxides, nitrogen oxides, fluorides, ammonia compounds, hydrocarbons, etc. When compared the urban air to open country, the urban air contains 10 times more dust particles, SO₂ concentration is 5 times higher, CO₂ concentration is 10 times higher and CO concentration is 25 times higher. In 70-80 % of monitored cities the permitted value of pollutants according to the WHO was exceeded at least once, e.g. there were different developments in Eastern and Western Europe in case of SO₂, positive trends relate to strict emission standards and industrial restructuring.

Green areas are starting to play an important role especially in urban settlements in relation to global warming and climate change, in particular as regards:

- increasing temperature (first of all summer heats),
- decreasing relative air humidity.

Micro-climate function is understood as ability of green areas to affect by their transpiration activities the air humidity, to provide shade, to decrease changes in temperatures, etc. For example a large birch can evaporate as much as 7,000 litres of water during vegetation period, street trees can remove sulphur dioxide and reduce particulates by up to 75%¹², city parks reduce temperature by 1°C when compared to temperature on streets (on average). Green areas increase air humidity (by 5 to 7 % on average).

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¹² Biodiversity by Design, A guide for sustainable communities, Town and Country Planning Association, 2004
**Insulation function** is understood as ability of green areas to reduce noise, catch dust, absorb xenobiotic substances, etc. E.g. 50-year old maple (*Acer platanoides*) absorbs 0.0295 kg of sulphur, 0.0860 kg of chlorine and 0.0039 kg of fluorine during vegetation period. Woods and bushes have positive impacts on air quality, serve as filter for dust (studies present data on 20 g of dust particles per square metre of leaf surface). Reducing noise in urban areas and reducing wind speed are also important functions of vegetation. Noise attenuation can be as much as 30 dB per 100 metres\(^\text{13}\)

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\(\text{\textsuperscript{13}}\) The essential role of green infrastructure: eco-towns green infrastructure worksheet, TCPA, 2008

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Photo 1: The open space with the extreme low environmental quality
1.2.2 Biodiversity conservation

It is estimated in UNEP’s Global Biodiversity Assessment that on a global level biodiversity is decreasing at a faster rate now than at any other time in the past. The situation in Europe is also a cause for concern. The rich biodiversity of the European Union has been subject to slow changes over the centuries, due to the impact of human activities. The importance of urban biodiversity is constantly increasing given that 2007 was the first year where more people lived in urban rather than in rural areas. Cities occupy just 2% of the surface area of the planet, but absorb a staggering 75% of the world’s natural resources. Urban biodiversity may refer to plants and animals that occur within the built environment (facades, roofs, balcony) or it may refer to remaining biodiversity that occurred in the natural greenspaces (e.g. city forests) , or other types of the open urban spaces. All of the areas, animals and plants which are present in the city are contributing to its biological diversity. Therefore it is necessary to create proper conditions to support biodiversity at urban level and in designing and creating particular open urban spaces at local level. In the context of the biodiversity conservation, the spontaneously occurring plants and animals are at the centre of interest (Werner, 2009)¹⁴

There are following roles of open urban spaces in biodiversity protection:

- **Topical / Refugial function** of open areas – ability to provide animals with refugee, nesting, etc. creation of refugees for plants and animals which are pushed away from intensively used landscape
- **Trophical function** of open areas – plants growing on the open urban spaces as sources of food for various animals.

The different intensity of use and differentiated intensities of maintenance with respect of the natural processes is very important when we are intending to achieve the higher level of biodiversity. The relevant hierarchy of the open urban spaces (see chapter 1.1) is therefore very necessary.

¹⁴Werner,P. Zahner, R.: Biologische Vielfalt and Stadte, 2009
1.2.3 Ecosystem services

The ecosystem services are very closely linked to the biodiversity issues of open urban spaces. Ecosystem services are those goods and services that are provided by or are attributes of ecosystems that benefit humans (Turner, 2004). According to the Millennium Ecosystem Assessment project, the ecosystem services in relation to the greenspaces for human well-being (MEA 2005) are as follows:

- Natural green spaces are providing “provisioning services”: food, fresh water, wood and fibre, etc.
- Natural and anthropogenic green spaces are providing “regulating services”: climate, flood and disease regulation, water purification
- Natural green spaces are providing “supporting services”: water and nutrient cycling, soil formation, primary production,

Ecosystem services are directly linked not only to biodiversity protection but to micro-climate treatment as well. (see Chapter 1.2.1 a 1.2.4.1)

1.2.4 Threats to the urban environment and urban biodiversity

1.2.4.1 Climate change

Increasing amount of greenhouse gases is likely to speed up climate changes. The scientists expect that the average global temperature of the Earth surface could increase by 1.8 – 4.5 °C by 2100 (however with considerable regional differences in temperature growth), which corresponds to expected growth by 1.1 to 6.4 °C, as referred to in the 2004 report

15 TURNER REVIEW No. 9 Ecosystem services: an ecophysiological examination
17 The IPPC Fourth Report (February 2006).
Alteration of temperatures and rainfall will probably lead to **changes in natural ecosystems of the urban natural greenspaces.** Some forest ecosystems are likely to disappear with subsequent extinction of some species. Many **plant and animal species,** which will not be able to adapt to changed conditions, will be threatened and or will extinct (see the maps below\footnote{Ensuring quality of life in Europe’s cities and towns, Tackling the environmental challenges driven by European and global change, EEA report, 2009}).
Main biogeographic regions of Europe (EEA member countries)

- Arctic
- Arctic — Greenland (not EEA member)
- North-western Europe
- Central and eastern Europe
- Mountain areas
- Mediterranean region

It is logical to expect that due to climate changes these adverse trends and their impacts will be even more obvious in cities. The brief survey on climate change is documented on the basis of two climate indicators – air temperature and precipitation.

As it is mentioned in chapter 1.1.1 the urban environment differs considerably from surrounding landscape in a number of characteristics (temperature, humidity, air quality, etc.). It is logical to expect that due to climate changes these adverse trends and their impacts will be even more obvious in cities. The brief survey on climate change is documented on the basis of two climate indicators – air temperature and precipitation (drought and floods).

The open spaces – both civic and greenspaces – could play the crucial role in the mitigation of the negative impacts of the climate change and new measures and policies in the field of open urban spaces planning could serve in the field of adaptation to climate change consequences.

Photo 2: Climate change (urban heat island) as a factor in urban design
1.2.4.2 Affecting the hydrological cycle – tackling storm rainfall problems

Well planned and designed spaces can favourably affect the hydrological cycle in urban areas.

- Properly planned and designed open spaces provide an important opportunity to temporarily retain surface water during storms until this water is led away by a drainage system.
- Open spaces with permeable surface, along with retaining storm waters, enable also infiltration of these waters into soil, reducing so requirements for traditional sewerage systems.
- Green open spaces with important vegetation cover are also able to retain considerable amounts of rainfall. This rainfall can then evaporate into the atmosphere, increasing so air humidity, or can slowly infiltrate into soil.

1.2.4.3 Fragmentation and connectivity of greenspaces

Quantity and spatial relationships among particular greenspaces (both natural and anthropogenic) directly affect the conditions in biodiversity in the urban environment. The fragmentation of habitats by urbanisation has highlighted the need for habitat networks: continuous, linked areas of habitat. Fragmentation of natural elements raised a requirement to link natural elements to the local system of inter-connected natural elements at urban level. In the area of urbanism and urban planning through a spatial planning documentation it is possible and desirable to directly affect quantity and surface area of green spaces with a help of regulators in order to create a functioning ecological network. The development of the green system network is important not only for the transfer of species, but both for the usability of citizens. Whilst planning can create opportunities for habitats, urban form will influence their size and extent. Masterplanning of a community’s ‘green infrastructure’ can therefore play an important role in creating ecologically functional habitat networks. Connectivity not always constitutes a direct physical link between particular open spaces, though this should prevail. In case of transfer
of species an important role can be played by private lands and gardens which are not interlinked.

1.2.5 Indirect aspects related to the sustainable development – e.g. environmental education, health of the population, etc.

A number of studies have showed a direct relation between human health and physical activities in the open urban spaces, e.g. studies of eight European cities show that people who live in areas with abundant green open space are three times more likely to be physically active and 40 % less likely to be overweight or obese (Ellaway et al., 2005).

School children who have access to, or even sight of, the natural environment show higher levels of attention than those without these benefits (Velarde et al., 2007).

Green areas are important for health because they:

- allow for contact with nature, promote recovery from stress, are beneficial for mental health and help improve behaviour and attention in children;
- encourage people to be physically active19

Photo 3: Practical environmental education of schoolchildren

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19 Ensuring quality of life in Europe’s cities and towns, Tackling the environmental challenges driven by European and global change, EEA report, 2009
2. Project case studies illustrating the application of the theoretical issues in a practical context of specific projects - both positive and negative examples possible

Impact of open urban spaces, and especially greenspaces, on improving the urban microclimate is very closely linked to other aspects which were dealt with in the theoretical part above. Therefore, the other aspects will overlap in the number of selected case studies. Moreover, our case studies will be examples on a number of levels from the local through the district up to the city levels.

- Climatic amelioration of the urban environment – project case studies Bratislava
- Biodiversity conservation – BO1 Malmo
- Threats to the urban environment and urban biodiversity - Climate change - Augustenborg, fragmentation – Hammersby Sjoestadt

Photo 4: Augustenborg, Malmo (Sweden)
2.1.1 Positive Case Study 1

Ecological aspects of open urban spaces described:

- Climate change
- Biodiversity

Austenborg (Sweden)

District Level - revitalization

Introduction/Context

Augustenborg (the part of the city Malmo) used to belong to the most progressive districts of the Swedish post-war building industry. Unlike the poor districts, there were flats equipped with a bathroom with hot water, refrigerators and other devices not usual for that period. Documents from 1950s provide information that 5 tonnes of coal per hour used to be combusted in this district to heat the hot water. However, as the time was rolling by, the conditions in this district started to change and in 1970s there were various signs of decline.

Big problems were constituted, along with transportation and poor condition of houses, by annual floods due to heavy rainfall and insufficient sewerage capacity to absorb huge amounts of water. Many inhabitants from the middle and higher social classes have moved away, leaving place for increased unemployment and criminality. In 1997, a revitalisation project started involving the local inhabitants into the process from the very beginning. There were many meetings where problems were formulated and solutions sought. Managers of blocks of flats calculated individual payments for heat and hot water in order to motivate the inhabitants to more responsible behaviour and reduction of their ecological footprint.
Project description

Along with the transfer to alternative energy sources (at present in the district there are 450 m² of solar panels and 100 m² of photovoltaic cells producing hot water, heat and electricity) and idea of community car fleet with electric vehicles, there is a unique system of rain water management. This water is caught and transported through a sophisticated system into collection ponds, which serve also as an aesthetic components and favourably contributing to the biodiversity protection. Green roofs also play an important role as they catch as much as 50 % of rain water. The largest green roof in Scandinavia covering 9,500 m² is located in the Botanical Green Roof Garden. Green roofs are built on all new buildings, everywhere where it is technically feasible. The inhabitants were directly involved in planning and implementing the district green areas and this approach led to significant positive achievements.

Discussion/Evaluation in relation to the theme of the Working Paper

There are following reasons why we have decided to include the Augustenborg district revitalisation project in the case studies: progressive solution of water management (the system of collection ponds) with a growing importance with regard to climate change (droughts combined with heavy rainfalls). These components contribute to climate amelioration and biodiversity protection. Good involvement of local inhabitants from the very beginning of revitalisation is also considered to be very important.
Photo 5: Augustenborg – rainwater management
2.1.2 Positive Case Study 2

Ecological aspects of open urban spaces described:

- **Biodiversity**
- Climatic amelioration of the urban environment

**Malmo Western Docks Bo01 (Vastra Hamnen, Sweden)**

**District Level – new constructions**

**Introduction/Context**

The Vastra Hamnen district belongs to the excellent projects. This project, however, is not focused on reconstruction of a residential area, the starting position is different here. The territory was strongly industrialised and contaminated. Along with the landing port, there was also a huge industrial complex for construction of civil ships. The city had a rather complicated task when it decided to revitalise in the sense of sustainable development, as it had to cope with old environmental burdens. Today, a 190 metres high skyscraper “turning torso” by the architect Santiago Calatrava dominates the whole territory with an extraordinarily imaginative architecture, high-quality public spaces, the system of water retention similar to Augustenborg. Low-energy and energy-passive buildings, solar panels, energy from alternative sources, green roofs, support of biodiversity through sophisticated design of public spaces create an attractive district. There is also a well-treated entrance to the sea which is a popular meeting point and place of trips for the inhabitants of Malmo.

**Project description**

Nature is present in the city district due to the conscious planning system. The biodiversity issues were promoted through the creation of the high quality green spaces,
green roofs and green walls. There is a strategy for all plants and trees in yards and gardens, e.g. some of the plants were chosen for their nectar productivity. The local water management system is not only attractive for inhabitants and visitors (canals, ponds and fountains), but also very good for the environment, because the water is biologically cleaned up. A ‘Green Space Factor’ has required each property developer put in place measures to enhance biodiversity and manage rainwater. Every developer had to choose 10 out of 35 Green Points which included:

- At least 50 species of native herbs in the courtyard
- All walls covered with climbing plants
- All roofs are green roofs
- A bird box for every flat
- Food for birds all year round in the courtyard
- Facades to have swallow nesting facilities
- Bat boxes in the courtyard
- A habitat for specified insects in the courtyard
- Courtyard vegetation selected to be nectar giving
- A 1m² pond for every 5m² of sealed area in the courtyard
- Courtyard amphibian habitats with space for hibernation
- The whole courtyard to consist of semi-natural biotopes
- A section of the courtyard to be left to natural succession (TCPA, 2004).

**Discussion/Evaluation in relation to the theme of the Working Paper**

Vastra Hamnen Bo01 is a great example of creation of public spaces to support biodiversity.
Photo 6: Vastra Hamnen Bo01 Malmo
2.1.3 Positive Case Study 3

Ecological aspects of open urban spaces described:

- Fragmentation and connectivity
- Climatic amelioration of the urban environment

Hammarby Sjoestad (Stockholm, Sweden)

District Level – new constructions

Introduction/Context

The capital of Sweden – Stockholm – has recently gained a prize “European Green Capital”. This prize is awarded for achievements in the quality of the environment, but also for plans which the city council has laid down for the next period. The territory of Hammarby Sjoestad, similar to Vastra Hamnen in Malmo, used to be devastated by industry, landfills, etc. At present, there is a settlement district built for 20,000 inhabitants (the project will be completed in 2015). 1,000 jobs have been created in this territory in order to maintain the functions of the territory. Originally there had been a plan to build an Olympic village with a strong focus on the environmental aspect – Sweden submitted an application for organisation of the Olympic Games in 2004. Although, this candidature was not successful, implementation of this project started. The construction is rather urban than suburban, with boulevards, clearly defined and architectonically diverse housing blocks and commercial areas. The biodiversity of the territory, creation of new habitats for various animal species, rainfall retention are maximally supported.
Project description

The network of various greenspaces, parks and walkways runs through the whole district. The existing vegetation has been saved. The original rushes and reeds are remaining along the water front – the new secured walkways have been build into the water (reedpark with oil wooden footbridges, see the photo). “Ecoducts”, i.e. green viaducts over the highway, connecting the nature reserve Nacka with the residential area, have been built for better migration of animal species. The territory is built-up up to 50 %, with 30 m² of green areas per capita within 300 m distance from any flat. The architecture of buildings has been modified due to the protection of oak vegetation on the slope.

A common denominator of success has always been an initiative and efforts of local authorities, cooperation within a multi-sectoral team and especially communication and direct involvement of inhabitants into the projects.
Discussion/Evaluation in relation to the theme of the Working Paper

In case of Hammarsby Sjöestad it is necessary to stress the efforts to achieve a connection among various open spaces fulfilling various functions, importance and management level into one unit. The ecoducts linking the nature reserve Nacka with the residential area are especially important. Protection of open urban spaces against bad weather conditions (winds) offers also a good example in this respect.

Photo 8: Hammarsby Sjöestadt - reedpark with oil wooden footbridges
2.1.4 Positive Case Study 4

Ecological aspects of open urban spaces described:

- **Climatic amelioration of the urban environment**

**Bratislava, Palisády**

**Local Level – revitalization**

A unique project was implemented in Bratislava with the aim to improve the environmental quality. Removal of bituminous surface between trees allowed to increase the share of vegetation, to support aeration of the root system of trees and to support water management since increasing the share of unpaved surfaces has also increased the infiltration of rain water (water permeability).
Photo 9,10: Bratislava, revitalisation of Palisady street
2.1.5 Negative Case Study 5

Ecological aspects of open urban spaces described:

- Climatic amelioration of the urban environment

Záhorská Bystrica Bratislava

Local Level – new construction

A newly built square is situated in the central part of Záhorská Bystrica district, which is a part of the city of Bratislava. Záhorská Bystrica is located 15 km from the city centre and is often presented as a suitable place for living as it offers housing on a city periphery with rural elements of life. The square should serve especially to the inhabitants, but during my relatively frequent visits it is usually empty. In summers it does not provide sufficient shading, there is lack of vegetation; the square is dominated by paving. The project was prepared and implemented only by developer, supplier and architect without involvement of the future inhabitants.

Discussion/Evaluation in relation to the theme of the Working Paper

Priorisation of other functions and aspects over the environmental aspect, ignoring the citizens and other inhabitants of a city district by planning, absolute lack of vegetation components.

Photo 11: Bratislava, city district Zahorska Bystrica – new square neglecting the environmental aspect
“In the true nature of things, if we rightly consider, every green tree is far more glorious than if it were made of gold and silver.” – Martin Luther

3. Conclusion: Implications of the subject matter of the working paper for good design of urban spaces (Check list)

When setting concrete environmental criteria and standards of „open urban spaces” it is necessary to take into account the whole range of requirements, not only in accordance with described environmental aspects (see the Chapter 1). However, at the same time it is necessary to comply with the principles of sustainable urbanism in accordance with a requirement for a compact city in order to avoid urban sprawl and fragmentation of the environment.

“Open space standards/criteria” should include:

- **Quantitative component** - e.g. amount, area, etc.
- **Qualitative component** – e.g. percentage of vegetation, percentage of sealed surfaces, percentage of woody plant coverage and other additional indexes in accordance with functional use of „open space”
- **Accessibility component** – dealing with the need to create inter-linked networks of open spaces, with their proper distribution in the territory and with determination of proper attraction territories for inhabitants

These standards should take into account various hierarchies of importance of open spaces, scales (city scale, district scale, local scale) as well as their prevailing functions.
3.1 Quantitative component and accessibility component

An ecologically balanced settlement is a settlement with more than 40\(^{20}\)-60\(^{21}\)% of area covered by vegetation (in planning the “eco” districts in the UK - as a general rule - 40% of land, both private and public, should be given over to green infrastructure). Based on currently known data it is possible to say that the average need for the green areas in a built-up territory of a settlement is around 65 m\(^2\) per inhabitant.

- **Examples of quantitative standards currently used**

  In the UK the Government Planning Policy Guidance No. 17, named Planning Open Spaces, Surfaces for Sport and Recreation, deals not only with green areas (regardless how broadly this notion is defined) but also with open public spaces which provide space for recreation and are valuable also from visual and aesthetic points of view.

  A standard of the National Playing Field Association (NPFA) lays down **2.43 ha of sporting areas and playgrounds per 1,000 inhabitants** (known as “6 acre standard”).

  In 2008, a revision of this standard was carried out and this standard is called now **Planning and Design for Outdoor Sport and Play standard** quantitatively defining 1.6 hectares of recreation green areas and 0.8 hectares of playgrounds for children per 1,000 inhabitants.

  A number of British municipal councils have similarly adopted a standard of so called amenity open spaces, which represents **0.5 - 0.8 ha per 1,000 inhabitants**, to be applied in case of new construction activities\(^{22}\). From the point of view of biodiversity protection there is a known indicator of quality of life for urban inhabitants, representing **1 ha of natural components per 1,000 inhabitants**.

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\(^{20}\) The essential role of green infrastructure: eco-towns green infrastructure worksheet, TCAP, 2008

\(^{21}\) Standards of minimal infrastructure of municipalities (Methodological Guide for authors of spatial planning documentation, Ministry of the Environment of the Slovak Republic, 2002)

\(^{22}\) RETHINKING OPEN SPACE OPEN SPACE PROVISION AND MANAGEMENT: A WAY FORWARD, Kit Campbell Associates, Edinburgh, The Scottish Executive Central Research Unit 2001
The CitySpace planning initiative in Chicago (USA) aims is to bring all communities up to a standard of two acres of open space per 1,000 residents by 2010\textsuperscript{23}.

According to other approaches, it is necessary to take into account not only the size of green areas but its distribution within city as well, that means the accessibility of open spaces from the most distant place (zone) of a city or to be defined by the method of catchment areas.

From the point of view of various European policies, green areas and public spaces, their proportion and accessibility are included among the indicators of sustainable urban development (e.g. the European Common Indicators, STATUS\textsuperscript{24}, TISSUE\textsuperscript{25}). In the framework of these sets of sustainable urban development indicators the accessibility of open spaces is monitored as follows:

Open spaces are defined as:

- Public parks, gardens or open spaces serving exclusively to pedestrians and bikers, cemeteries (if the municipal self-government agrees with their recreational function or natural, historic and cultural values);
- Open sporting areas accessible for the public free of charge;
- Private areas (private parks) accessible for the public free of charge;

Accessibility is defined as living within a distance of 300 metres from a public space.

The UK applies a similar approach where the accessibility of open spaces is expressed by distance or by time of pedestrian walk to a green area or to an area of short-term recreation. Typical indicators are:

\begin{itemize}
  \item Public space lessons, Adapting public space to climate change , Cabe,p.3, www.cabe.org.uk
  \item Sustainability Tools and Targets for the Urban Thematic Strategy
  \item Trends and indicators to monitor the Urban Environment Thematic Strategy
\end{itemize}
- Playgrounds for small children, accessibility within 90 m
- Playgrounds for children of 10-13 years of age, accessibility within 300 m
- Playgrounds for children of 14-18 years of age, accessibility within 1,000 m
- Sporting areas, accessibility within 1,000 m
- Parks, accessibility within 400 m
- Amenity open spaces, accessibility within 400 m

Accessibility of green areas is widely used for particular categories of green areas according to their importance for a settlement:

- Parks and public spaces or regional importance: accessibility within 8 km (pursuant to London Planning Advisory Committee, LPAC, 1992)
- Parks of urban importance: accessibility within 3.2 km (pursuant to London Planning Advisory Committee, LPAC, 1992)
- Parks of district importance: accessibility within 1.2 km (LDPETA, 1992) or 2.5 km (Dundee City Council, 1999 and Glasgow City Council, 1997)

Examples of other standards in the area include „The Natural England Accessible Natural Greenspace Standards“:

- No person should live more than 300 metres from their nearest area of natural green space of at least 2 hectares in size.
- At least 1 hectare of Local Nature Reserve should be provided per 1,000 population.
- There should be at least one accessible 20 hectare green space site within 2 kilometres from home.
- There should be one accessible 100 hectare green space site within 5 kilometres.
- There should be one accessible 500 hectare green space site within 10 kilometres.
In accordance with the Appendix C to the questionnaire 3.1.1 WP3, which defines the "Catalogue of main types and categories of urban open space" (the list slightly modified), we tried to define the criteria of quantity and accessibility for settlements with various numbers of inhabitants, while respecting the assumption of 70 (65) m² per inhabitant and 40 % coverage of the city territory by vegetation (see Table 1).
### Table 1 Quantitative component

<table>
<thead>
<tr>
<th>Open spaces</th>
<th>Indicator</th>
<th>STANDARD FOR SIZE CATEGORY OF MUNICIPALITIES IN THOUSANDS OF INHABITANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>category</td>
<td>5</td>
</tr>
<tr>
<td>Parks, public gardens and green spaces</td>
<td>Minimum park area</td>
<td>5 000 m², and minimal width 25m</td>
</tr>
<tr>
<td></td>
<td>[m²/inhabitant]</td>
<td>8-14</td>
</tr>
<tr>
<td>Local level</td>
<td>[m²/inhabitant]</td>
<td>8-14</td>
</tr>
<tr>
<td></td>
<td>accessibility</td>
<td>300 m</td>
</tr>
<tr>
<td>District level</td>
<td>[m²/inhabitant]</td>
<td>2-5</td>
</tr>
<tr>
<td></td>
<td>accessibility</td>
<td>-</td>
</tr>
<tr>
<td>City level</td>
<td>minimum area [ha]</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>accessibility</td>
<td>-</td>
</tr>
<tr>
<td>Other green spaces</td>
<td>Playgrounds, sport facilities min. area [ha]/1000 inhabitants</td>
<td>0.8 ha per 1,000 inhabitants</td>
</tr>
<tr>
<td>• Playgrounds for small children</td>
<td>Accessibility within up to 150 m</td>
<td>up to 150 m</td>
</tr>
<tr>
<td>• Playgrounds for children of 10-13</td>
<td>Accessibility within up to 300 m</td>
<td>up to 300 m</td>
</tr>
<tr>
<td>Open spaces</td>
<td>Indicator</td>
<td>≤ 5</td>
</tr>
<tr>
<td>-------------------------------------------------</td>
<td>------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>• Playgrounds for children of 14-18</td>
<td>Accessibility within</td>
<td>1000 m</td>
</tr>
<tr>
<td>• Botanic and ZOO gardens</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
<tr>
<td>• Cemeteries</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
<tr>
<td>• Campsites</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
<tr>
<td>Civic space (sealed surfaces), roads and other transport routes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Urban squares and plazas</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
<tr>
<td>Local level accessibility</td>
<td></td>
<td>300 m</td>
</tr>
<tr>
<td>District level accessibility</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>City level accessibility</td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>• Pedestrian streets</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
<tr>
<td>• Residential streets</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
<tr>
<td>• Other roads</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
<tr>
<td>• Urban motorway corridors</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
<tr>
<td>• Car parks</td>
<td>min. area [ha]</td>
<td>unlimited</td>
</tr>
</tbody>
</table>
## Open spaces

### STANDARD FOR SIZE CATEGORY OF MUNICIPALITIES IN THOUSANDS OF INHABITANTS

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicator</th>
<th>5</th>
<th>5–10</th>
<th>10–20</th>
<th>20–30</th>
<th>30–50</th>
<th>50–100</th>
<th>&gt;100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cycle routes</td>
<td>length</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Railway lines and embankments</td>
<td>min. area [ha]</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Private gardens</td>
<td>[m²/house]</td>
<td>(100)*</td>
<td>(100)*</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Incidental open spaces in low-rise residential areas</td>
<td>[m²/inhabitant]</td>
<td>10-15</td>
<td>8</td>
<td>8-12</td>
<td>8-12</td>
<td>8-12</td>
<td>8-12</td>
<td>8-12</td>
</tr>
<tr>
<td>Communal open space in multi-storey housing</td>
<td>[m²/inhabitant]</td>
<td>-</td>
<td>8</td>
<td>8-12</td>
<td>8-12</td>
<td>8-12</td>
<td>8-12</td>
<td>8-12</td>
</tr>
<tr>
<td>Green roofs and balconies</td>
<td>min. area [ha]</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Historic open spaces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formerly private parks and gardens associated with historic buildings</td>
<td>min. area [ha]</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Historic public parks and gardens</td>
<td>min. area [ha]</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>External spaces in relation to buildings</td>
<td>[m²/inhabitant]</td>
<td>12-14</td>
<td>12-14</td>
<td>12-14</td>
<td>12-14</td>
<td>12-14</td>
<td>12-14</td>
<td>12-14</td>
</tr>
<tr>
<td>Pre-school and educational facilities (from kindergartens up to university centres)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pre-school min. area [m²]</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>educational min. area [ha]</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>[m²/student]</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>faculties [ha]</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Open spaces</td>
<td>Indicator</td>
<td>5 ≤ 50</td>
<td>50 &gt; 100</td>
<td>100 &gt; 200</td>
<td>200 &gt; 300</td>
<td>300 &gt; 400</td>
<td>400 &gt; 500</td>
<td>500 &gt; 600</td>
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<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
<td>-----------</td>
</tr>
<tr>
<td>universities [ha]</td>
<td>60</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>[m²/student]</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Hospitals and care homes</td>
<td>min. area [ha]</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
</tr>
<tr>
<td>[m²/bed]</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
</tr>
<tr>
<td>• Public and accommodation buildings</td>
<td>min. area [m²]</td>
<td>(200)*</td>
<td>(200)*</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
</tr>
<tr>
<td>• Health care buildings and facilities</td>
<td>min. area [ha]</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
<td>0.5-2</td>
</tr>
<tr>
<td>[m²/bed]</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
<td>80-130</td>
</tr>
<tr>
<td>• Recreational and spa centres</td>
<td>min. area [ha]</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>• Trade and shopping centres</td>
<td>min. area [ha]</td>
<td>(1)*</td>
<td>(1)*</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>• Uncultivated agricultural soil</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>• Forests and afforested areas</td>
<td>[m²/inhabitant]</td>
<td>(50)*</td>
<td>(50)*</td>
<td>(50)*</td>
<td>(50)*</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>• Waste landfills and dredging sites</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>• Other unused open spaces</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Production and industrial areas</td>
<td>[m²/inhabitant]</td>
<td>12-26</td>
<td>12-26</td>
<td>12-26</td>
<td>12-26</td>
<td>12-26</td>
<td>12-26</td>
<td>12-26</td>
</tr>
<tr>
<td>Open spaces</td>
<td>STANDARD FOR SIZE CATEGORY OF MUNICIPALITIES IN THOUSANDS OF INHABITANTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-------------</td>
<td>-----------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>category</td>
<td>Indicator</td>
<td>▼ 5</td>
<td>5 &gt; 10</td>
<td>10 &gt; 20</td>
<td>20 &gt; 30</td>
<td>30 &gt; 50</td>
<td>50 &gt; 100</td>
<td>▲ 100</td>
</tr>
<tr>
<td>• Zone of isolating green areas (according to type)</td>
<td>min. strip [m]</td>
<td>(5-150)*</td>
<td>5-150</td>
<td>5-150</td>
<td>5-150</td>
<td>5-150</td>
<td>5-150</td>
<td>5-150</td>
</tr>
</tbody>
</table>

**Note:**
(x)* - recommended infrastructure
(x)** - facilities with prevailing curative nature
3.2 Qualitative component

At present it is clear that it is necessary to define not only the quantitative aspect and the accessibility aspect but it is necessary to deal also with the quality of green areas and open spaces to maintain favorable conditions of the environment in urban areas. This will assure proper micro-climate in the urbanised environment, air quality, rain water management and growth of retention capacity of a territory, support of biodiversity, etc. All these important factors were described in the theoretical part of this document.

Examples of qualitative standards used at present

Spatial planning practice applies the indicators of built-up areas index (expressing the ratio of built-up areas in the affected territory to the entire area of the territory in question) and coefficient of green areas, specifying the ratio between green areas and the total area of the given territory.

In accordance with „Standarts for open spaces in build up areas“ in Graz (Austria) (Freiraumplanische standards fur die Baulandgestaltung)26 various qualitative standards according to territory’s functionality are applied. The index of “impermeableness”27 is especially important for rain water management in the urbanised territory. It is calculated as percentage according to surface type as follows:

No impermeableness (0 %)

- lawn, carpet lawn and other vegetation area

Semi-impermeableness (50 %):

- paving with increased interspaces
- grass concrete
- porous paving in gravel bed

---

26 „Freiraumplanische standards fur die Baulandgestaltung“, Graz
27 Die Versiegelung
Impermeableness (67 %):

- paving in sand bed

**100 % impermeableness:**

- Asphalt
- paving in mortar bed
- Built-up area

Result is average permeability expressed as sum of permeability according to particular surface types in the given territory.

Photo 12: Paving as important factor to secure the permeability of the area

Along with that, the final calculation includes the area of green roofs (if vegetation roofs are located in the given territory), where the area of green roof within the total balance of areas is calculated as follows:
- Thickness of soil layer 8 – 15 cm – calculated as 60 % impermeableness
- Thickness of soil layer 15 – 30 cm – calculated as 45 % impermeableness
- Thickness of soil layer 30 – 50 cm – calculated as 20 % impermeableness

Photo 13: Paving as important factor to secure the permeability of the area
A so called “green space factor” was applied in the Swedish city Malmo in building a new district Vastra Hamnen. The “green space factor” ensures that each plot has a minimum amount of greenery, and on a scale of 0 to 1 the average factor must be at least 0.5. Values of “green space factor” according to particular surface types (from impervious surface rates as 0.0, a tree 0.4 and a green roof 0.8) are provided below:

Type of area

- Vegetation: area where the plant roots have direct contact with deeper soil layers, and water can freely percolate to ground water level. (1)
- Vegetation: area where the plant roots don't have direct contact with deeper soil layers, for example on top of underground car park. Soil depth less than 800mm. (0.6)
- Vegetation: area where the plant roots don't have direct contact with deeper soil layers, for example on top of underground car park. Soil depth more than 800mm (0.8)
● Green roofs, brown roofs, eco-roofs: calculated for the real area covered by plants, not the area of the roof as projected on the ground surface (0.8)
● Open water in ponds, trenches and so on: the area should be under water for at least 6 months/year (1.0)
● Non permeable areas, including the house built on the plot (0)
● Stone paved areas, with joints where water can infiltrate (0.2)
● Semi permeable areas: sand, gravel, etc. (0.4)
● Green walls: climbing plants with or without support. The area of a wall that can be expected to be covered by vegetation within five years. Maximum calculated height: 10 meters (0.7)
● Trees with a stem girth of more than 35 cm: calculated for the maximum area of 25 m2 for each tree (0.4)
● Shrubs higher than three meters: calculated for the maximum area of 5 m2 for each shrub (0.2)\(^{28}\)

Photo 15: Green space factor in practice
A similar approach has been selected also in the city of Berlin - successful and comprehensive green factor programme in place called **the Biotope Area Factor** (BAF).

Values of BAF factor for particular surface types for calculation are as follows:

<table>
<thead>
<tr>
<th>Surface type</th>
<th>Factor value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Built-up surface</td>
<td>0.0</td>
</tr>
<tr>
<td>Partially built-up surface</td>
<td>0.3</td>
</tr>
<tr>
<td>50% built-up surface</td>
<td>0.5</td>
</tr>
<tr>
<td>Surface of vegetation without contact with deeper soil layers (thickness of soil layer below 80 cm)</td>
<td>0.5</td>
</tr>
<tr>
<td>Surface of vegetation without contact with deeper soil layers (thickness of soil layer above 80 cm)</td>
<td>0.7</td>
</tr>
<tr>
<td>Surface of vegetation with direct contact with deeper soil layers</td>
<td>1.0</td>
</tr>
<tr>
<td>Polders (surface) for infiltration of rain water</td>
<td>0.2</td>
</tr>
<tr>
<td>Vertical greening</td>
<td>0.5</td>
</tr>
<tr>
<td>Green roof</td>
<td>0.7</td>
</tr>
</tbody>
</table>

The value is calculated according to the formula:
(... m² of surface type • factor x value) + (...m² of surface type • factor x value) + ...

BFF=

-----

... m² of total area of land

BAF value ranges from 0.6 (residential areas) to 0.3 (industrial zones)29

The so called “eco-index” is also known. It represents ratio between water-permeable surfaces and amount of green areas. The eco-index consists of two components – basic eco-index and complementary eco-index (eix). To calculate the eco-index it is necessary to know the area of:

- un-built surfaces

- their division to sealed and unsealed surfaces

Unsealed surfaces have to be divided according to vegetation type. It is also necessary to define the area of water surfaces. Each surface type is given a determined value of its eco-index, based on which the value of basic eco-index is calculated.

**Calculation of basic eco-index**

Area of particular types of un-built surfaces is changed to fictive, weighed eco-areas after multiplying by a corresponding eco-factor. The basic eco-index is provided as a ratio of a sum of eco-areas to the real area of un-built surfaces.

Value of eco-factor of particular areas for calculation of basic eco-index:

### Table: Eco-factors for Surfaces

<table>
<thead>
<tr>
<th>Surface Type</th>
<th>Sealed Surfaces</th>
<th>Mowed Grass Surfaces</th>
<th>Inundation and Polder Surfaces</th>
<th>Natural Unmowed Grass Surfaces</th>
<th>Surfaces with Low Shrubby Vegetation</th>
<th>Water Surfaces</th>
<th>Surfaces with Tree and Higher Shrubby Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eco-factor</td>
<td>0.0</td>
<td>0.5</td>
<td>0.5</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>2.0</td>
</tr>
</tbody>
</table>

The complementary eco-index is calculated based on the size of a groundplan of solitaire tree crown planted on sealed surfaces and built-up surfaces and based on the size of surfaces of vegetation on horizontal, sloping and vertical surfaces of exterior structures of overground and underground constructions.

**Calculation of complementary eco-index**

The complementary eco-index is calculated in the following way:

- from the area of tree crown groundplans and vegetation on structures by multiplying by a corresponding eco-factor a fictive eco-surface is calculated; after dividing by real size of un-built surfaces the value of complementary eco-index is resulted.

**Values of eco-factor for calculation of complementary eco-index:**

- Groundplan of tree crown...................................................2.0;
- Vegetation on structures....................................................0.5.

The resulted eco-index $E_{ix}$ is a sum of the basic and complementary eco-indexes.

The theoretical maximum value of the basic eco-index is 2.0 which corresponds to a built-up area in a continuous tree vegetation without any fixed surfaces. The size of
complementary eco-index can theoretically reach the value around 1.0 in high density of a built-up area with green facades and roofs (Kováč, 2009).

In qualitative criteria with relation to particular vegetation types and open spaces we have selected some of the approaches described above, namely:

- **% of vegetation surfaces** – expressing the ratio of vegetation surfaces to total surface
- **% of coverage by woody plants** – expressing the ratio of woody plant surfaces to total vegetation surface
- **% of impermeableness** – expressed as a sum of permeability according to particular surface types on a given area,

as well as some other qualitative standards (see in Table 2).
### Table 2 Quantitative component

<table>
<thead>
<tr>
<th>Open spaces</th>
<th>STANDARDFORSIZECATEGORYOFMUNICIPALITIESINTHOUSANDSOFINHABITANTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>facility</td>
<td>indicator</td>
</tr>
<tr>
<td><strong>Parks, public gardens and green spaces</strong></td>
<td>[% of vegetation surfaces]</td>
</tr>
<tr>
<td></td>
<td>[% of coverage by woody plants]</td>
</tr>
<tr>
<td><strong>Local level</strong></td>
<td>[% of vegetation surfaces]</td>
</tr>
<tr>
<td></td>
<td>[% of coverage by woody plants]</td>
</tr>
<tr>
<td><strong>District level</strong></td>
<td>[% of vegetation surfaces]</td>
</tr>
<tr>
<td></td>
<td>[% of coverage by woody plants]</td>
</tr>
<tr>
<td><strong>City level</strong></td>
<td>[% of vegetation surfaces]</td>
</tr>
<tr>
<td></td>
<td>[% of coverage by woody plants]</td>
</tr>
<tr>
<td><strong>Other green spaces</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Playgrounds, sport facilities</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td>• <strong>Botanic and ZOO gardens</strong></td>
<td>unlimited</td>
</tr>
<tr>
<td>• <strong>Cemeteries</strong></td>
<td>unlimited</td>
</tr>
</tbody>
</table>
## Open spaces

<table>
<thead>
<tr>
<th>Facility</th>
<th>Indicator</th>
<th>≤ 5</th>
<th>5 &gt; 10</th>
<th>10 &gt; 20</th>
<th>20 &gt; 30</th>
<th>30 &gt; 50</th>
<th>50 &gt; 100</th>
<th>&gt; 100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Campsites</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Civic space (sealed surfaces), roads and transport routes</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Urban squares and plazas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Local level [% of vegetation surfaces]</td>
<td>Min. 30%</td>
<td>Min. 30%</td>
<td>Min. 30%</td>
<td>Min. 30%</td>
<td>Min. 30%</td>
<td>Min. 30%</td>
<td>Min. 30%</td>
<td></td>
</tr>
<tr>
<td>Index of impermeableness</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td></td>
</tr>
<tr>
<td>District level [% of vegetation surfaces]</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td>Index of impermeableness</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td></td>
</tr>
<tr>
<td>City level [% of vegetation surfaces]</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td>20%</td>
<td></td>
</tr>
<tr>
<td>Index of impermeableness</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td></td>
</tr>
<tr>
<td>Pedestrian streets</td>
<td>Index of impermeableness</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td>max. 45%</td>
<td></td>
</tr>
<tr>
<td>Residential streets</td>
<td>Number of trees per 1 km</td>
<td>80 pc as minimum</td>
<td>80 pc as minimum</td>
<td>80 pc as minimum</td>
<td>80 pc as minimum</td>
<td>80 pc as minimum</td>
<td>80 pc as minimum</td>
<td></td>
</tr>
<tr>
<td>Other roads</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td></td>
</tr>
<tr>
<td>Open spaces</td>
<td>STANDARD FOR SIZE CATEGORY OF MUNICIPALITIES IN THOUSANDS OF INHABITANTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>-----------------------------------------</td>
<td>-------------------------------------------------------------------------</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>facility</td>
<td>indicator</td>
<td>▼ 5</td>
<td>5 † 10</td>
<td>10 † 20</td>
<td>20 † 30</td>
<td>30 † 50</td>
<td>50 † 100</td>
<td>▼ 100</td>
</tr>
<tr>
<td>Urban motorway corridors</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Car parks</td>
<td>Index of impermeableness</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
</tr>
<tr>
<td>Cycle routes</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Railway lines and embankments</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Residential open spaces and housing landscape</td>
<td>[% of vegetation surfaces]</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>Private gardens</td>
<td>[% of vegetation surfaces]</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Incidental open spaces in low-rise residential areas</td>
<td>[% of coverage by woody plants]</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Communal open space in multi-storey housing</td>
<td>[% of coverage by woody plants]</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Green roofs and balconies</td>
<td>[% of vegetation surfaces]</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Historic open spaces</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Formerly private parks and gardens</td>
<td>[% of vegetation surfaces]</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Historic public parks and gardens</td>
<td>[% of vegetation surfaces]</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>External spaces in relation to buildings</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Open spaces</td>
<td>indicator</td>
<td>&lt;5</td>
<td>5–10</td>
<td>10–20</td>
<td>20–30</td>
<td>30–50</td>
<td>50–100</td>
<td>&gt;100</td>
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</tr>
<tr>
<td>Pre-school and educational facilities (from kindergartens up to university centres)</td>
<td>[% of vegetation surfaces]</td>
<td>min. 40%</td>
<td>min. 40%</td>
<td>min. 40%</td>
<td>min. 40%</td>
<td>min. 40%</td>
<td>min. 40%</td>
<td>min. 40%</td>
</tr>
<tr>
<td></td>
<td>[% of coverage by woody plants]</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Hospitals and care homes</td>
<td>[% of vegetation surfaces]</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
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<tr>
<td></td>
<td>[% of coverage by woody plants]</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Public and accommodation buildings</td>
<td>[% of vegetation surfaces]</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
</tr>
<tr>
<td>Health care buildings and facilities</td>
<td>[% of vegetation surfaces]</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
</tr>
<tr>
<td></td>
<td>[% of coverage by woody plants]</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Sport facilities</td>
<td>[% of built-up surface]</td>
<td>(50)*</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Recreational and spa centres</td>
<td>[% of vegetation surfaces]</td>
<td>min. 50%</td>
<td>min. 50%</td>
<td>min. 50%</td>
<td>min. 50%</td>
<td>min. 50%</td>
<td>min. 50%</td>
<td>min. 50%</td>
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<tr>
<td></td>
<td>[% of coverage by woody plants]</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>Cultural and educational centres</td>
<td>[% of vegetation surfaces]</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
<td>min. 30%</td>
</tr>
<tr>
<td></td>
<td>Index of impermeableness</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
<td>max. 40%</td>
</tr>
<tr>
<td>Trade and shopping centres</td>
<td>[% of vegetation surfaces]</td>
<td>min. 15%</td>
<td>min. 15%</td>
<td>min. 15%</td>
<td>min. 15%</td>
<td>min. 15%</td>
<td>min. 15%</td>
<td>min. 15%</td>
</tr>
<tr>
<td></td>
<td>Index of impermeableness</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
<td>max. 60%</td>
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</tr>
<tr>
<td>Open spaces</td>
<td>STANDARD FOR SIZE CATEGORY OF MUNICIPALITIES IN THOUSANDS OF INHABITANTS</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>facility</td>
<td>indicator</td>
<td>5</td>
<td>5 10</td>
<td>10 20</td>
<td>20 30</td>
<td>30 50</td>
<td>50 100</td>
<td>100</td>
</tr>
<tr>
<td>Urban peripheries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Uncultivated agricultural soil</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>- Forests and afforested areas</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>- Waste landfills and dredging sites</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>- Other unused open spaces</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
<td>unlimited</td>
</tr>
<tr>
<td>Production and industrial areas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[min. % of coverage by woody plants]</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
<td>80%</td>
</tr>
<tr>
<td>- Zone of isolating green areas (according to type)</td>
<td>min. strip [m]</td>
<td>(5-150)*</td>
<td>5-150</td>
<td>5-150</td>
<td>5-150</td>
<td>5-150</td>
<td>5-150</td>
<td>5-150</td>
</tr>
<tr>
<td></td>
<td>woody plants [%]</td>
<td>(80)*</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
<td>80</td>
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<tr>
<td></td>
<td>lawns [%]</td>
<td>(20)*</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

**Note:**
(x)* - recommended infrastructure
(x)** - facilities with prevailing curative nature
Along with this there are other standards which cannot be expressed in a table form, e.g.:

1. **In the field of mitigating the adverse impacts of climate change**
   
   (Hudekova, 2007)\(^{30}\):
   
   - Generally, to design the vegetation composition in cities so as to enable better air circulation and to support the air movement and exchange of air at nights;
   - To increase the share of vegetation, especially in the built-up areas of urban centres (planting trees in streets and car parking areas, green dividing strips, using alternative types of vegetation, green roofs catching and slowing down the water runoff, climbing and vertical vegetation, etc.)
   - The percentage of trees and woody plants should be more than 60 % (in relation to lawns)
   - Use of water component – fountains, watercourses, catching the rain water – roof and terrace water collection systems can lead to collection ditches and to collection ponds. Pavements and sealed surfaces can be gradient so that water can run to vegetation.
   - To increase retention capacity of the territory – e.g. to maximally use permeable materials and structures and replace impermeable materials (asphalt, concrete) with such materials.
   - Introduction of new species (taxons) which have not been suitable for our conditions by now (e.g. due to temperature demands)\(^{31}\);
   - Introduction of new woody plants resistant to strong summer droughts (e.g. with narrow leaves)

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\(^{30}\) Hudekova Z. et al.: Ecological Footprint, Climate Change and Cities, Regional Environmental Center, Country Office Slovakia; 2007

In accordance with the expected temperature increase it is necessary to prepare for changes (shifts) in altitudinal vegetation zones affecting the selection of basic woody plants to be planted in urban areas\textsuperscript{32}

To avoid the planting of some invasive woody plants (\textit{Ailanthus altissima}, \textit{Negundo aceroides}) distribution of which is supported by increasing temperature.

2. In the field of the of biodiversity promotion\textsuperscript{33}:

- Planting of native trees and bushes from a regional origin
- An enclosure of a green space which is constructed in a barrier-free way for small animals (for example hedgehog, amphibians)
- A bird nesting box for each apartment. Bat boxes for each plot
- Part of some open spaces left to grow by natural succession
- Enhance connectivity of biotopes
- Creating green belts or protection belts alongside water bodies
- Composting of green waste from private households
- Promotion of area successions
- Near-natural mowing of selected municipal open spaces (at most 1-2 times per year. Date of mowing to consider late-blooming plants, insects and ground nesting birds)
- General cessation of the use of fertilizers (mineral and organic)
- General cessation of the use of synthetically produced mineral fertilizer
- Use of regionally produced compost
- General cessation of the use of plant protection agents and pesticides

\textsuperscript{32} Jaroslav Machovec: Sadovnická dendrologia, SPN Praha, str.107

\textsuperscript{33} Wettbewerb Bundeshauptstadt im Naturschutz, DUH 2007
- General cessation of the use of pesticides or the use of organic pest control measures
- General cessation of the use of de-icing salt, except for hazardous road sections
- General abandonment of peat
- Allowing the establishment of un-mown verges (e.g. under fences)
- Promotion of nutrient deficient habitats not applying humic layers to open landsides, slopes, etc.

Photo 16: Natural areas have an immense importance also in urban environment
3. In the field of the provision of proper climate conditions

Along with the above mentioned standards it is necessary to consider the provision of proper climate conditions for staying in open urban spaces, i.e. summer heats, protection from cold wind, rain, noise reduction etc.

Summer heats can be moderated:

- by means of shielding (panels, pergolas or textile shielding in streets),
- by using bright colours and shiny surfaces which reflect radiation better than dark ones,
- by using especially deciduous trees, that are making shade in summer and during winter they permit solar exposure on the site

Protection from wind, rain and noise:

- by creating protection against winds (vegetation barriers, glazing, panels). The dense tree canopy act as a wind breaks\(^{34}\), when they are placed at the prevailing wind direction. The special importance have a evergreen trees. Vegetation has an immense importance also as sound barrier.
- The special examples are galleries (providing protection from rain) and sunken open spaces.

\(^{34}\) Project RUROS
Photo 17: Summer heats moderated by means of textile shielding in streets
References:

Kováč. B. (2009): „Spatial plan as a tool for regulation of territory. a lecture and a textbook from the seminar "Regulatory tools in Slovakia and in the Czech Republic “. Bratislava. 16 April 2009

Hudeková. Z. (2008): Public urban spaces. a thesis. FA STUBA

Standards for minimal municipal infrastructure – A methodological guidance for contractors and authors of land-use planning documentation (Ministry of the Environment of the Slovak Republic. 2002)

Conclusions from the conference „Sustainable urban development and alleviating adverse impacts of climate change on quality of life and the urban environment“. Bratislava. 2007

Act 50/1976 on land-use planning and building code (Building Act)

Act 543/2002 on nature and landscape protection


Machovec, J: Sadovnická dendrologia. SPN Praha. str.107


Ensuring quality of life in Europe's cities and towns, Tackling the environmental challenges driven by European and global change, EEA report, 2009


Werner, P. Zahner, R.: Biologische Vielfalt and Stadte, 2009
TURNER REVIEW No. 9 Ecosystem services: an ecophysiological examination


The IPPC Fourth Report, February 2006


The essential role of green infrastructure: eco-towns green infrastructure worksheet, TCAP, 2008

„Freiraumplanische standards für die Baulandgestaltung“, Graz
Public space lessons, Adapting public space to climate change , Cabe, www.cabe.org.uk


Wettbewerb Bundeshauptstadt im Naturschutz, DUH, 2007
Information from the web pages and projects:

http://www.stadtentwicklung.berlin.de/umwelt/landschaftsplanung/handbuch/de/biotopflaechenfaktor/index.shtml

http://news.bbc.co.uk/2/hi/europe/5413960.stm

http://www.i-sustain.com/index.php?option=com_docman&task=cat_view&gid=100&Itemid=152

URGE – Development of urban green Spaces to improve the quality of life in cities and urban regions, http://www.urge-project.ufz.de

RUROS – Rediscovering the Urban Realm and open Spaces, http://alpha.cres.gr/ruros


project “Capitals of biodiversity”, http://www.capital-biodiversity.eu/